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The fossil on the cover is *Nipponitella explicata* HANZAWA, an aberrant uncoiled fusulinacean from the Lower Permian Sakamotozawa Formation, southern Kitakami, Northeast Japan.

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722. INOCERAMIDS DISCOVERED FROM THE UWAJIMA GROUP IN THE CHIKANAGA DISTRICT, WESTERN SHIKOKU, JAPAN

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Abstract. A number of pelecypod fossils belonging to *Inoceramus yabei, I. teshioensis,* and *I. uwajimensis* were discovered from the Shimanto Terrain in the Chikanaga district to the east of Uwajima, western Shikoku. This paper is concerned with their brief descriptions and with their significances on the stratigraphy of the Shimanto Supergroup. These inoceramids indicate Gyliakian to Urakawan ages and the existence of strata in the Chikanaga district which are synchronous with the Uwajima Group in the type area. In addition to the occurrence of an early Miyakoan ammonoid *Cheloniceras* (NAKAI and HADA, 1966), these fossils suggest that the shelf-facies Uwajima Group conformably overlies the geosynclinal facies Shimanto Group. It is confirmed not only from the biostratigraphical standpoint of view, but also from the lithostratigraphy, geologic structures and field observations. Taking the recently published report on the presence of the shallow sea strata within the geosynclinal ones in the Yukawa district of Western Kii Peninsula (NAKAZAWA *et al.*, 1979) into consideration, the above-mentioned features give a clue to elucidate the tectonic development of the northern marginal part of the Shimanto Geosyncline.

Introduction

The wide area on the south of the Butsuzo tectonic line in Southwest Japan and Kanto mountain is called the Shimanto Terrain. It is further divided into two areas; one is the Shimanto Terrain in a narrow sense on the north and the other is the Setogawa-Nakamura Terrain on the south. The strata distributed in the Shimanto Terrain in a narrow sense are called the *Shimanto Supergroup* in Shikoku.

The Shimanto Supergroup consists mainly of clastic rocks with subordinate basic volcanics, chert, lentils of limestone and acid tuffs as minor constituents. Owing to the scarcity of guide fossils, the relatively monotonous lithofacies and the complicated geologic structures, the detailed stratigraphy and geologic structure of this supergroup are not yet fully clarified except for such districts as Akaishi Mountain (KIMURA, 1967; KIMURA and TOKUYAMA, 1971; TOKUYAMA, 1973; OGAWA, 1978) and a part of Kii Peninsula (HASHIMOTO, 1968; MOROZUMI, 1970a, b). According to the evidences of fossils from some limited places, the strata of the Shimanto Supergroup are mostly of the Cretaceous (MATSUMOTO, 1954). However, some Jurassic strata may be included, because of the occurrence of such Upper Jurassic fossils as *Opis* (*Trigonopis*) aff. *corallina* DAMON from

* Received June 2, 1980; read June 29, 1980 at the 125th Meeting of the Society at Kochi.

Kashiwagi, Nara Prefecture (ICHIKAWA, 1954) and Upper Jurassic to Upper Cretaceous radiolarians from Eastern Shikoku (NAKASEKO, 1979; NAKASEKO *et al.*, 1979).

In the Uwajima and its adjacent districts of Western Shikoku are distributed the Upper Cretaceous fossiliferous strata called the Uwajima Group. A large number of marine fossils as ammonoids, bivalves and echinoids occur at various horizons of this group (TANABE, 1972; TERAOKA and OBATA, 1975). In addition to them, it yields such plant fossils, as *Archaeozostera*, which indicates a very shallow sea with the influence of fresh water (KORIBA and MIKI, 1931). Furthermore, some thick conglomerates and thin coal seams occur. These facts show that the Uwajima Group is mainly composed of deposits of shelf-facies in a shallow sea. According to TANABE (1972), this group of the type area ranges from the Cenomanian to lower Campanian (Japanese Gyliakian to Urakawan) in age, although about its upper and lower limits there are some different opinions (NAKANO, 1964; TERAOKA and OBATA, 1975).

The Shimanto Group, limestone-bearing strata of geosynclinal facies, are distributed around the Uwajima Group. A part of the Shimanto Group is called the Kitanada Formation in the southern Uwajima district. Strata, which are thought to be almost contemporaneous with this formation, are also distributed in the southern, western and eastern parts of the Chikanaga district to the east of Uwajima (SUGAI, in KOBAYASHI, 1950) (Text-fig. 2). The age of this formation is now considered to be Aptian to Albian, because some Aptian ammonoids occur from its lower part at the south of Chikanaga (NAKAI and HADA, 1966), and because *Pterophyton* cf. *miyakoense* YABE, which is comparable with a species from the Aptian-Albian Miyako Group, occurs from a limestone at Kuninaga, south of Uwajima (KOBAYASHI, 1950).

The strata synchronous with the Uwajima Group are also distributed in the central main part of the Chikanaga district (YEHARA, 1924; SUZUKI, 1935, 1936; SUGAI, 1935; NAGAI *et al.*, 1967; TERAOKA and OBATA, 1975). NAGAI *et al.* (1967) listed some Inocerami from the Chikanaga district in the explanatory text of the geologic map of Ehime Prefecture (1/200,000). Recently, TERAOKA and OBATA (1975) clarified the existence of Coniacian to Santonian strata in the southern part of the Chikanaga district. However, the detailed stratigraphy and geologic structures in this district are not yet fully studied. Furthermore, the stratigraphical and structural relationship between the Uwajima Group and the Shimanto Group in this district, remain uncertain, although a conformable relationship between the two is confirmed by KUDO (1949) and TANABE (1972) in the Uwajima district.

The Shimanto Superoup is partly shallow sea sediments as already pointed by MATSUMOTO and HIRATA (1969), HAYAMI (1969) and others. Very recently NAKAZAWA *et al.* (1979) described some shallow marine bivalve fossils of Aptian to Albian ages from the sandstones of the Yukawa Formation (HIRAYAMA and TANAKA, 1956) in the area just to the south of the Butsuzo tectonic line in the Kii Peninsula. Moreover, they clarified from the sedimentological standpoint that the fossil bearing sandstones were deposited under a neritic environment. Occurrences of Aptian-Albian neritic ammonoids and bivalves in Central Shikoku (MATSUMOTO *et al.*, 1952; HAYAMI and KAWASAWA, 1967; *etc.*) show that a shelf existed along the northern marginal part of the Shimanto Geosyncline at that time. The position corresponds to the region

adjacent to the present-day Butsuzo tectonic line. The strata of the Urakawan shelf-facies occur also near Terasoma in the Kii Peninsula (MOROZUMI, 1970 a, b) (Text-fig. 1). The relation between the strata of the shelf-facies and the geosynclinal facies is conformable in the above-mentioned districts.

The writer discovered many specimens of Inocerami from the strata in the Chikanaga district. They indicate various ages from Cenomanian to Santonian (Gyliakian to Urakawan). In addition to the Coniacian and Santonian fossils reported already (TERAOKA and OBATA, 1975), discovery of the Cenomanian to Turonian Inocerami gives a clue to elucidate the stratigraphical relationship between the Uwajima Group of the shelf-facies and the Shimanto Group of the geosynclinal facies. In this paper the writer gives brief stratigraphic and palaeontologic descriptions, and discusses the significance of the discovered fossils for the age determination of the Shimanto Supergroup.

The classification of the Inoceramidae, especially the definition and application of many generic and subgeneric names, is still controversial. Recent studies on the Japanese species of Cretaceous inoceramids were undertaken by HAYAMI (1975), NODA (1975), NODA and MATSUMOTO (1976), KAUFFMAN in MATSUMOTO (1977) and some others. Because each species often shows wide geographic distribution, this is actually a problem beyond the writer's knowledge on a local faunule. In this paper the writer tentatively referred three described species to *Inoceramus* (s. s.) in agreement with most of these writers.

Acknowledgements

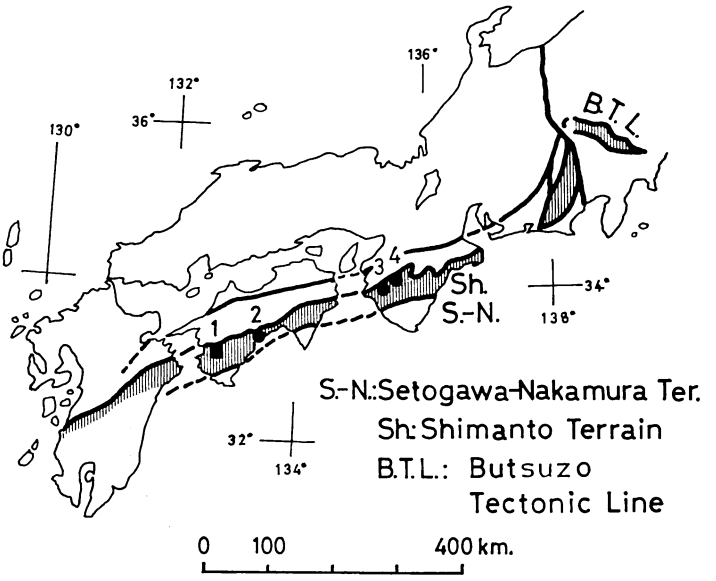
This study was commenced under the direction of Professor Toshio KIMURA of the University of Tokyo, who gave the writer a consistent guidance during the field and laboratory works. The writer expresses his hearty appreciation to Associate Professor Itaru HAYAMI for his pertinent instruction in the identification of specimens and critical reading of the manuscript, and to Dr. Tomowo OZAWA for his valuable advice and ceaseless encouragement in the course of this study. And his gratitude is due to Dr. Fujio TOYOHARA of the University of Tokyo for his instructive suggestions, and to Dr. Ken'ichi KANO of the Shizuoka University and Mr. Tanio ITO of the University of Tokyo for their kind help in various way.

Note on lithostratigraphy

The strata in this district are lithologically divided into six formations, which are Formation-**a**, -**b**, —and Formation-**f**, in upward sequence (Text-figs. 2, 3). Taking fossils collected into consideration, it is presumable that Formation-**a**, -**b** and -**c** correspond to the Kitanada Formation of TANABE (1972), and that Formation-**d**, -**e** and -**f** are roughly synchronous with the Uwajima Group defined by TANABE (1972).

Formation-**a** (900 m.) consists mainly of sandstone, alternated beds of sandstone and mudstone, and submarine sliding deposits, intercalated by a few layers of acid tuff.

Formation-**b** (350 m.), lying on Formation-**a** conformably, is exclusively composed of bedded sandy mudstone except for alternation of sandstone and mudstone with an intercalation of acid tuff. The sandy mudstone is micaceous and contains abundant thin laminae of fine-grained sandstone. Carbonized plant fragments are sometimes found.



Text-fig. 1. Index map. 1: Chikanaga district; 2: Central Shikoku; 3: Terasoma district; 4: Yukawa district.

Formation-**c** (350 m.) is chiefly composed of submarine sliding deposits (olistostrome), associated with minor amount of calcareous bedded mudstone. Several huge blocks of limestone (olistolith) are contained.

Formation-**d** (320 m.), which conformably overlies Formation-**c**, comprises massive, shale-patch-bearing sandstone with subordinated mudstone and alternating beds of sandstone and mudstone. The sandstone is feldspathic and contains abundant carbonized plant fragments at some horizons. Interformational conglomerate, 15 meters in maximum thickness, is often found in the northwestern part of this district. Plant fossil, *Archaeozostera*, reported at Nagatani (Loc. 25 in Text-fig. 5) by NAGAI *et al.* (1967) occurs within this Formation.

Formation-**e** (50-300 m.) covers Formation-**d** with conformity. It contains chiefly submarine sliding deposits (slump breccia).

Formation-**f** (2,000 m.), which conformably covers Formation-**e**, is composed of sandstone, sandy mudstone and alternations of sandstone and mudstone with lentils of submarine sliding deposits and a few layers of acid tuff. The sandstone is lithic and intercalates cobble-bearing conglomerate. The sandy mudstone is generally massive, but sometimes bedded.

Two Aptian ammonites, *Cheloniceras* (*Cheloniceras*) *shimizui* NAKAI and HADA, and *Cheloniceras* (*Cheloniceras*) aff. *minimum* CASEY, occur from Formation-**b** (Loc. 38) (NAKAI and HADA, 1966). The writer also collected some ammonite fragments of the same species from the same locality. Furthermore, ammonite fragments, which can not be identified, because of the ill-preservation, were also collected from two pointos to the west of Chikanaga (Locs. 38, 40).

Fossils of *Inoceramus* are often found

in Formation-**f**. Three species are represented in the present collection; they are *Inoceramus yabei, Inoceramus teshioensis* and *Inoceramus uwajimensis*. These fossils are generally poorly preserved but worthy to be described, because they seem to give a foundation to the geology of the Shimanto Terrain.

Systematic description

Class Bivalvia

Subclass Pteriomorphia BEURLEN, 1944

Order Pterioida NEWELL, 1965

Suorder Pteriina NEWELL, 1965

Family Inoceramidae GIEBEL, 1852

Genus *Inoceramus* SOWERBY, 1814

Subgenus *Inoceramus* SOWERBY, 1814

Inoceramus (*Inoceramus*) *yabei* NAGAO and MATSUMOTO

Pl. 50, Figs. 1-4

Synonymy.—See HAYAMI (1975, p. 52).

Type.—The spesimen illustrated by NAGAO and MATSUMOTO (1939, pl. 34, figs. 6a, b; IGPS cat. no. 22685) was designated by MATSUMOTO and HARADA (1964, p. 96) as the lectotype of *Inoceramus yabei*.

Material.—The following description is based on four specimens in the present collection; an internal mould of articulated valves (MM 5713), a left internal mould (MM 5714) and two right internal moulds (MM 5715, MM 5716).

Description.—Shell moderate in size, subequivalve or inequivalve, inequilateral, roughly flabelliform in outline, as long as high or higher than long. Antero-dorsal margin nearly straight or slightly excavated; Postero-dorsal also long, straight or slightly arched. Beak variable in prominence but generally more prominent in left valve than in right. Beak angle generally obtuse (120°-140°). Antero-dorsal marginal part nearly perpendicular to the comisure plane.

Surface sculptured with comarginal ridges and rings; the ridges rather inconspicuous and finer on the umbonal region, elevated in the main part of the valve, asymmetrically wavy in cross section with subangular to angular top and flattened bottom, relatively irregular in interval and prominence. Concentric rings present on the ribs as well as the interspaces, usually low and irregular in breadth.

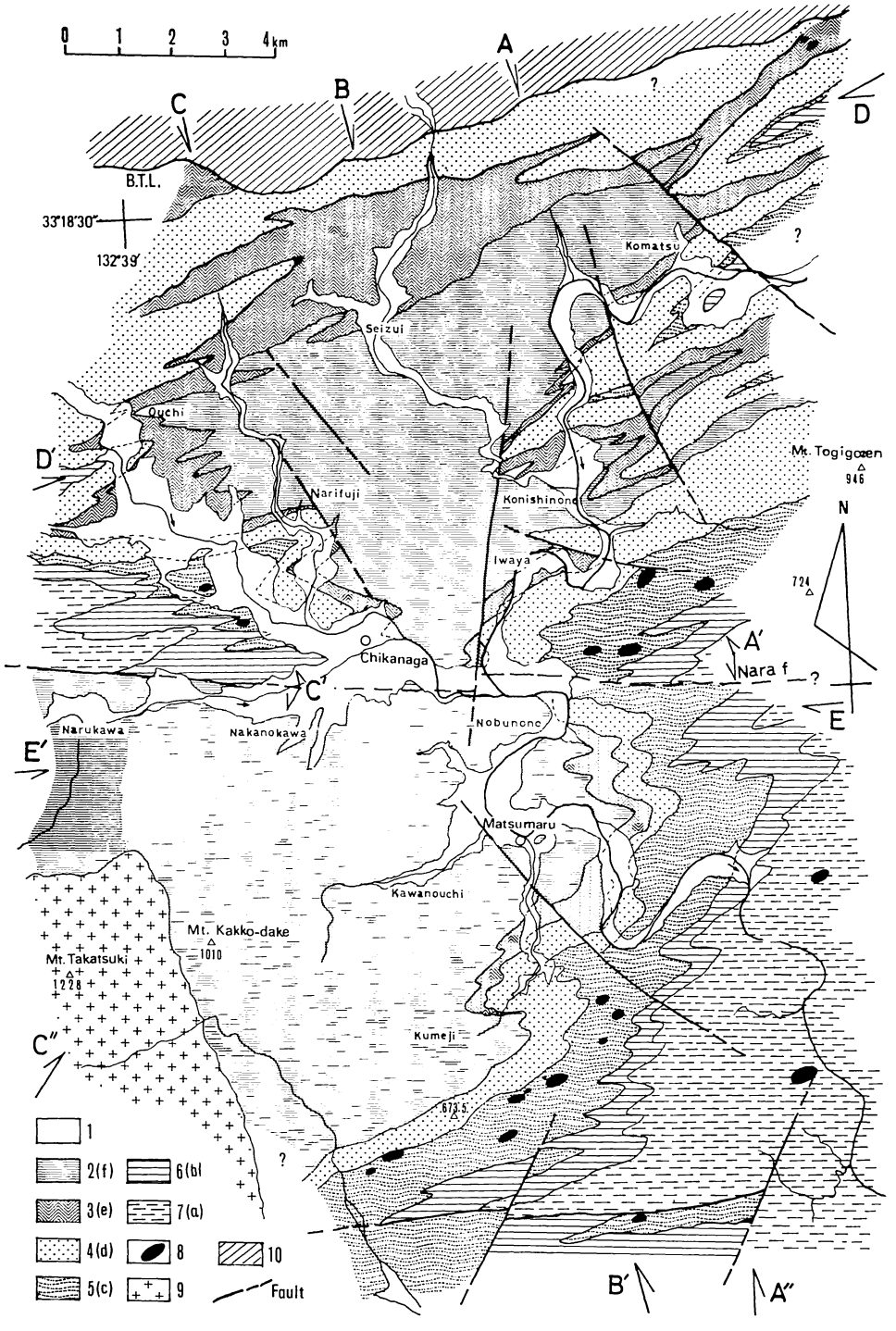
Observation and comparison. — The present specimens are more or less suffered from the secondary deformation, and the ventral part of these specimens is incompetely preserved.

Although they are somewhat smaller in size than the specimens described by NAGAO and MATSUMOTO (1939), all the essential characters, especially the surface ornamentation and the shell outline, are quite identical with *Inoceramus* (*Inoceramus*) *yabei* NAGAO and MATSUMOTO.

Some of specimens are similar to *Inoceramus teshioensis* NAGAO and MATSUMOTO in outline, but they can readily be distinguished from that species by the surface ornamentation.

Occurrence.—Fine sandy mudstone at Loc. 1, Ouchi, Mima-cho (MM 5713, MM 5714). Similar specimens were collected from the sandy mudstone at Loc. 2, about 300 meters southwest of Loc. 1. The other specimen was collected from shale patch-bearing sandy mudstone at Loc. 12, Narifuji, Hiromi-cho (MM 5715, MM 5716).

The species was previously reported from the Uwajima district without record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A
B
C
D
B.T.L.
33°18'30"
132°39'
Komatsu
Seizui
Ouchi
D'
Narifuji
Konishinono
Iwaya
Mt. Togigaen
946
N
724
A'
Nara f.
Chikanaga
C'
E
Narukawa
Nakanokawa
Nobunono
E'
Matsumaru
Kawanouchi
Mt. Kakko-dake
1010
Mt. Takatsuki
1228
C"
Kumeji
673.5
B'
A"
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4(d)
5(c)
6(b)
7(a)
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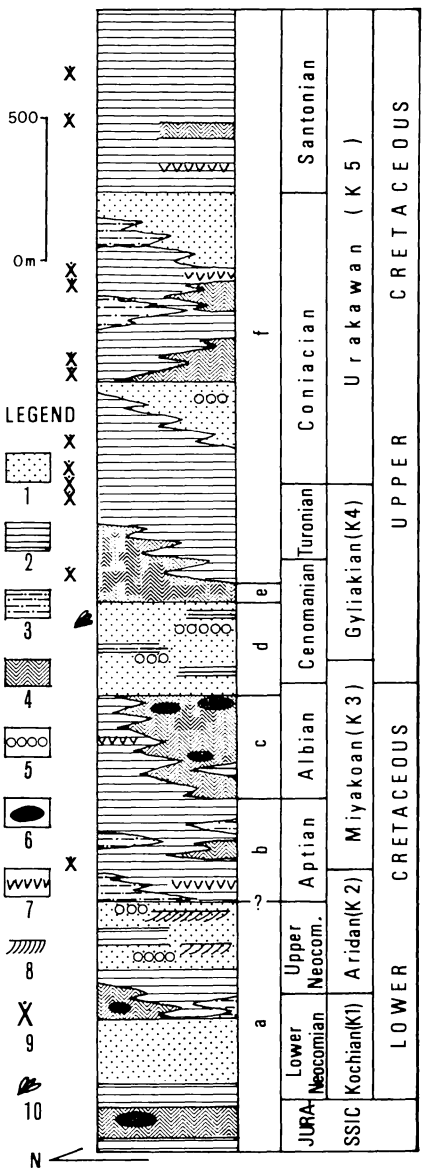


Text-fig. 3. Geologic columnar section of the Chikanaga district. 1: sandstone; 2: sandy mudstone; 3: alternation of sandstone and mudstone; 4: slump breccia; 5: conglomerate; 6: limestone; 7: acid tuff; 8: cross-stratification; 9: fossil; 10: plant fossil, *Archaeozostera*. a-f: Forwation **a**—**f**.

of the precise locality (NAGAO and MATSUMOTO, 1940, p. 5).

Inoceramus (*Inoceramus*) *teshioensis* NAGAO and MATSUMOTO

Pl. 50, Figs. 5-7

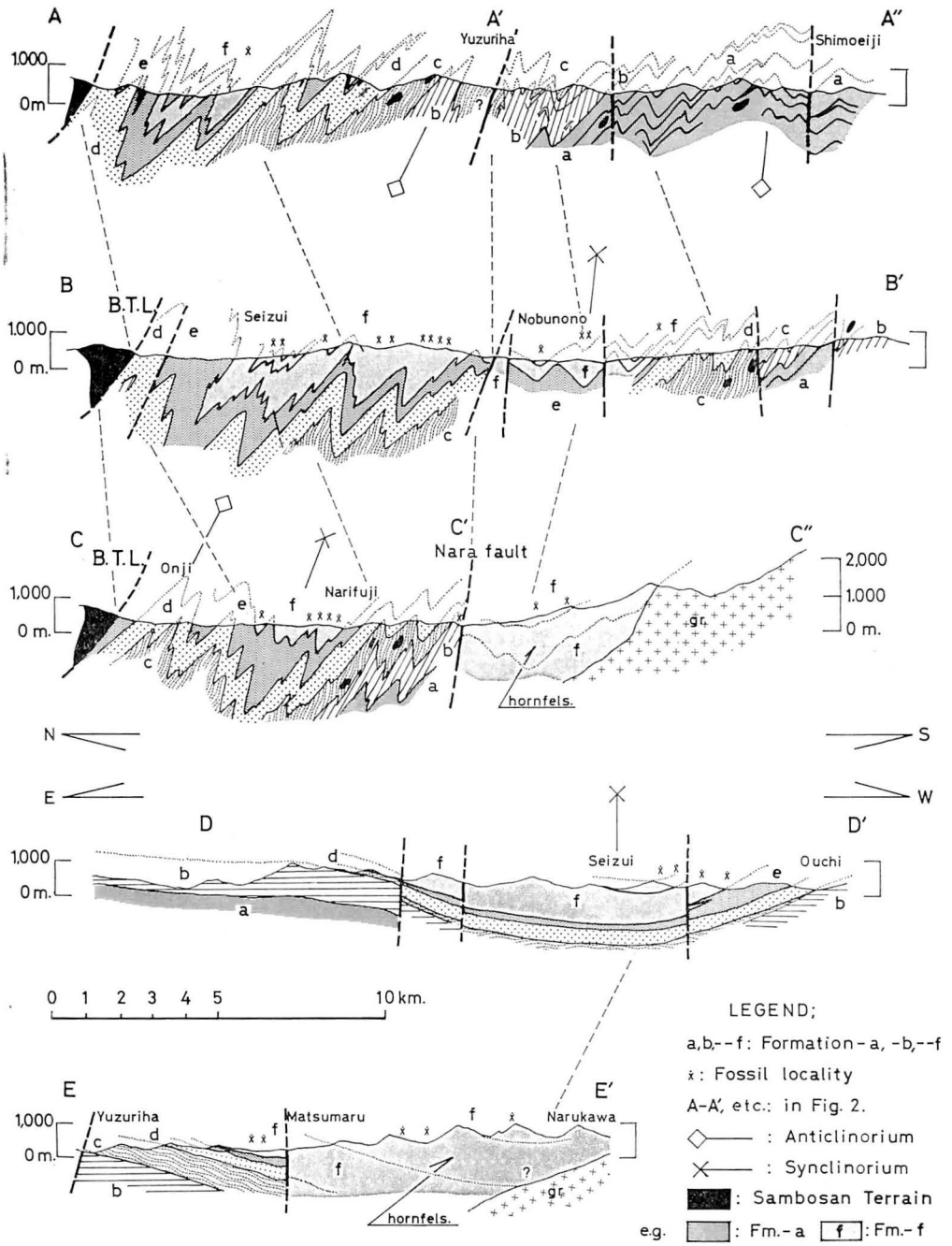
Synonymy.—See HAYAMI (1975, p. 53) and NODA (1975, p. 251).

Type.—The specimen illustrated by NAGAO and MATSUMOTO (1939, pl. 24, fig. 7; UMUT MM 6487 (=I-721)) was designated by NODA (1975, p. 252) as the lectotype of *Inoceramus teshioensis*.

Material.—The present sprecies is represented by three specimens in the present collection; a left internal mould (MM 5717, 24 mm. long, 36 mm. high), a left internal mould (MM 5718) and an internal mould of right and left valves (MM 5719).

Description.—Shell small or moderate in size, subequivalve, inequilateral, higher than long, considerably inflated; anterior part steeply inclined and nearly perpendicular to the plane of valve and concave. Antero-dorsal margin rounded, gradually passing to arcuate ventral and postero-ventral ones; ventral margin nearly semi-circular, passing upwards to the broadly curved posterior margin. Hinge-line of moderate length, nearly as

← Text-fig. 2. Geologic map of the Chikanaga district. 1: Quaternary sediments; 2: sandy mudstone and sandstone; 3: slump breccia; 4: feldspathic sandstone; 5: slump breccia; 6: bedded mudstone; 7: slump breccia, sandstone and mudstone; 8: limestone; 9: Miocene Takatsukiyama granitic rocks; 10: Sambosan Terrain. (a)—(f): Formation **a**—**f** in upward sequence. (see Text-figs. 3 and 4). A-A′-A″ etc: position of geologic cross setions (in Text-fig. 4).



Text-fig. 4. Geologic cross sections.

long as or slightly longer than a half of the shell-length (1/2).

Concentric undulation, rather low, asymmetically curved and regular in intensity and distance; concentric rings combined with the major concentric ribs which are somewhat asymmetrical in cross-section, separated by wider interspaces.

Observation and comparison.—From the above-mentioned characters, the present specimens are possibly identified with *Inoceramus* (*Inoceramus*) *teshioensis* NAGAO and MATSUMOTO. The present specimen (MM 5718) is especially similar in surface ornamentation to the specimen of this species illustrated by NODA (1975, pl. 35, fig. 2). One of the present specimen (MM 5717) has a ratio L/H smaller than the lectotype, illustrated by NAGAO and MATSUMOTO (1939, pl. 24, fig. 7), and furthermore, the umbo is remarkably prominent. These differences may be due to secondary deformations.

Occurrence.—Fine sandy mudstone at Loc. 28, Izume, Hiromi-cho (MM 5717, MM 5718) and calcareous sandy mudstone at Loc. 11, Katayama, Mima-cho (MM 5719).

Inoceramus (*Inoceramus*) *uwajimensis* YEHARA

Pl. 50, Figs. 8-13

Synonymy.—See HAYAMI (1975, p. 54) and NODA (1975, p.253).

Type.—The specimen illustrated by YEHARA (1924, pl. 3, fig. 2) was designated by MATSUMOTO in TAKAI and MATSUMOTO (1961, p. 273) as the lectotype of *Inoceramus uwajimensis*.

Material.—Eight specimens, which are relatively well-preserved, are concerned with description in the following lines. They are; a right internal mould (MM 5720, 36+mm. long, 44 mm. high), an internal moulds of right and left valves (MM 5721, 16+mm. long, 22 mm. high; MM 5722, 12+mm. long, 20+mm. high), a right internal mould (MM 5723, 42+mm. long, 58 mm. high), a right internal mould (MM 5724, 38+mm. long, 44 mm. high), two right internal moulds (MM 5725, MM 5726) and a right internal mould (MM 5727).

Description.—Shell very inequilateral, moderately convex with flattened sides. Antero-dorsal margin straight or slightly concave, passing gradually to broadly arched anterior one; ventral margin narrowly rounded with a subsymmetrical curvature. Posterodorsal wing-like area is generally not clearly defined except for one specimen (Text-fi. 9). Umbo terminal, incurved, pointed.

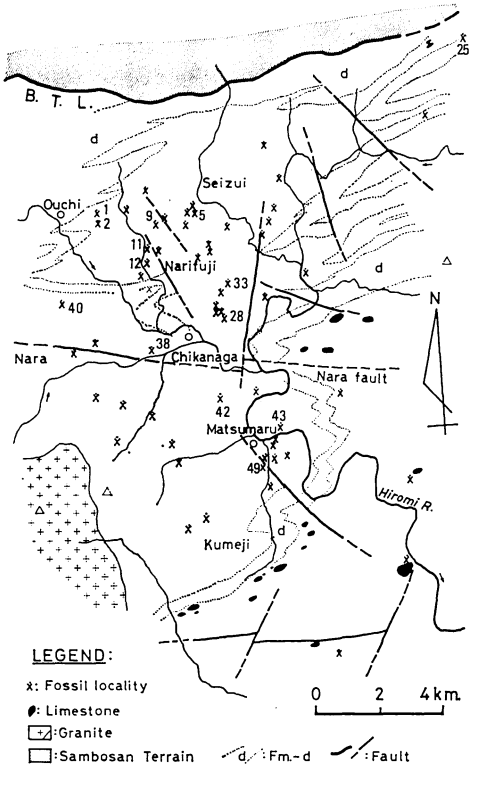
Surface ornamentation consists of numerous coarse, regular or somewhat irregular concentric ribs, separated by concave interspaces. Concentric ribs rather inconspicuous on the umbonal region, enlarged in the main part of valve and symmetrically wavy in cross-section with subangular to angular top.

Observation and comparison.—In many characters the present specimens closely resemble hitherto known species of *Inoceramus* (*Inoceramus*) *uwajimensis* YEHARA. The adult individuals of this species from the Uwajima Group, as represented by the lectotype and many other specimens, attain larger size. But in view of the ovate outline and the ratio of length/height and the prominency of umbo and low, sharp-topped concentric ribs and other characteristics, they must belong to this species.

One of the present specimens (MM 5721, MM 5722) is quite similar to the original specimens of *Inoceramus uwajimensis* var. *yeharai* NAGAO and MATSUMOTO, illustrated by NAGAO and MATSU-

MOTO (1939, pl. 34, figs, 2, 5, pl. 35, fig. 4). The variety was usually distinguished from the typical form of *Inoceramus uwajimensis* YEHARA by the developed posterior wing-like region, longer hinge-line, pentagonal outline and larger apical angle. In these respects the present specimen is transitional between the two forms.

One specimen (MM 5724) is apparently similar to *Inoceramus mihoensis* MATSUMOTO, which is characterized by the flabelliform outline and obtuse beak angle (MATSUMOTO, 1957, p. 65, pl. 21, figs. 1-4.). It was collected from a bed of somewhat higher horizon, where *Inoceramus uwajimensis* YEHARA coexist.



Text-fig. 5. Map showing the localities of fossils in the Chikanaga district. Fm.-d: Formation-**d** in Text-figs. 2-4.

Occurrence.—Fine sandy mudstone at Loc. 9, Katayama, Mima-cho (MM 5720), Loc. 42, Ketagawa, Mima-cho (MM 5721, MM 5722), Loc. 5, Seizui, Hiromi-cho (MM 5723), Loc. 49, Matsumaru, Matsuno-cho (MM 5724), Loc. 43, Nojiri, Matsuno-cho (MM 5725, MM 5726) and Loc. 33, Tanikirai, Hiromi-cho (MM 5727).

Concluding remarks

The newly discovered marine faunule from the Uwajima Group in the Chikanaga district is mainly composed of three species of bivalves as described above. In addition to them, ammonoids and echinoids were collected. Some specimens of *Inoceramus* (*Inoceramus*) *amakusensis* NAGAO and MATSUMOTO, being regarded as an index fossil of the Santonian, was also discovered from the upper part of this group in the southern area of this district.

According to MATSUMOTO (1959), the species *Inoceramus uwajimensis*, is restricted to occur from the Coniacian (Japanese lower Urakawan) throughout the Japanese Islands. It is, moreover, discovered from Sakhalin, Kamchatska, Alaska and California (NODA, 1975).

Inoceramus teshioensis is diagnostic of the Turonian (upper Gyliakian), especially upper Turonian age. It is fairly commom in the upper part of the Middle Yezo Group (Saku Formation and its equivalents), and in the Onogawa Group (Ryozen Formation).

The occurrence of *Inoceramus yabei* indicates a Cenomanian (Japanese lower Gyliakian) age (MATSUMOTO, 1967). This species has been found in the Middle Yezo Group (Mikasa Sandstone and its correlatives) of Hokkaido (MATSUMOTO and HARADA, 1964).

Recently, MATSUMOTO (1978) reported two Turonian species, *Inoceramus* (*Inocer-*

amus) *tenuistriatus* NAGAO and MATSUMOTO and *Mytiloides* cf. *incertus* (JIMBO) in the fossil collection of YEHARA. They had been collected near Narifuji, Hiromicho, without record of the precise locality. The writer discoved the described specimens of *Inoceramus yabei* also near Narifuji (Loc. 12).

Taking the occurrence of fossils mentiond above into consideration, it is now firmly concluded that the Uwajima Group (Formation-**d**, -**e** and -**f**) of the Chikanaga district ranges from the Cenomanian to the Santonian, although there is a possibility that its upper limit goes up to the lower Campanian. These palaeontological evidences are consistent with TANABE's opinion of the Uwajima Group in the type district.

Some species of *Inoceramus* are possibly pseudoplanktonic (HAYAMI, 1969). Therefore, sedimentary environment cannot necessarily be inferred from the occurrence of *Inoceramus*. The occurrence of the *Archaeozostera*-like plant fragments with *Inoceramus*, and the presence of thick conglomerate (40 m. in maximum thickness) and cross-laminated sandstone at several horizons, however, show that the deposition of the Uwajima Group took place under shallow shelf environment in the Chikanaga district.

It is an unsolved problem whether the Uwajima Group of shelf-facies is conformable with the Shimanto Group of geosynclinal facies or not. However, Formation-**b** and -**c** (synchronous with the Kitanada Formation) are Aptian to Albian in age, and Formation-**d**, -**e** and -**f** (the Uwajima Group) Cenomanian to Santonian in age (Text-fig. 3). The result of the field study on the boundary between Formation-**c** and -**d** also indicates a conformable relationship between the two. Therefore, the Uwajima Group is regarded as a part of the Shimanto Supergroup as pointed by TANABE (1972, p. 185).

As mentioned already, the Lower and Upper Cretaceous strata of shelf-facies are distributed in several districts along the northern margin of the Shimanto Terrain (Text-fig. 1). The srata of shelf-facies are also conformable with those of geosynclinal facies in those districts (KATTO, 1961; MOROZUMI, 1970a, b; NAKAZAWA *et al.*, 1979). In the light of the filling up the Shimanto Geosyncline, the Late Creatceous shelf, on which the Uwajima Group was deposited, has similar nature to the Early and Late Cretaceous shelves mentioned-above, although there is a difference in scale (YANAI, 1979, 1980).

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(J+E= in Japanese with English abstract)

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愛媛県南部，近永地域の宇和島層群から発見したイノセラムス化石：四国西部宇和島東方近永地域に分布する宇和島層群相当層より *Inoceramus yabei, I. teshioensis, I. uwajimensis* 等の多くの二枚貝化石を発見し，近永地域にも宇和島層群と同時代の陸棚層が存在することが再確認された。これらの二枚貝は，ギリヤーク世から浦河世にいたるもので，従来より報告されていた四万十層群プロパーからの宮古世前期のアンモナイト化石 *Cheloniceras* を含めて，生層序学的に地向斜相四万十層群（宮古世以前）と陸棚相宇和島層群（ギリヤーク—浦河世）

が整合関係で累重することが明白となった。また，このことは，地質調査によって解析された地層層序，地質構造，野外観察の結果とも調和的である。近永地域では．宇和島層群を堆積させた陸棚が，張り出すようにして発達し，地向斜相の堆積区は，北側から徐々に埋めたてられるようにして消滅したとみられる。最近報告された四万十帯北縁部湯川地域の浅海層の存在 (NAKAZAWA et al., 1979) に加えて，上記の事実は，四万十地向斜北縁部の構造発達史を知る上で，極めて興味深い。 柳井修一

Explanation of Plate 50

(All figures of natural size)

Inoceramus (*Inoceramus*) *yabei* NAGAO and MATSUMOTO .....p. 409

Fig. 1. Internal mould of conjoined valves (MM5713), Loc. 1, Ouchi, Mima-cho. 1a: lateral view of right valve; 1b: Left valve; 1c: dorsal view.

Fig. 2. Internal mould of left valve (MM5714), Loc. *ditto*.

Fig. 3. Right internal mould (MM5715), Loc. 12, Narifuji, Hiromi-cho.

Fig. 4. Right internal mould (MM5716), Loc. *ditto*.

Inoceramus (*Inoceramus*) *teshioensis* NAGAO and MATSUMOTO .....p. 411

Fig. 5. Left internal mould, tectonically deformed (MM5717), Loc. 28, Izume, Hiromi-cho.

Fig. 6. Left internal mould (MM5718), Loc. *ditto*.

Fig. 7. Internal moulds of both valves (MM5719), Loc. 11, Katayama, Mima-cho. 7a: lateral view of right valve; 7b: left valve.

Inoceramus (*Inoceramus*) *uwajimensis* YEHARA .....p. 413

Fig. 8. Internal mould of right valve (MM5720), Loc. 9, Katayama, Mima-cho.

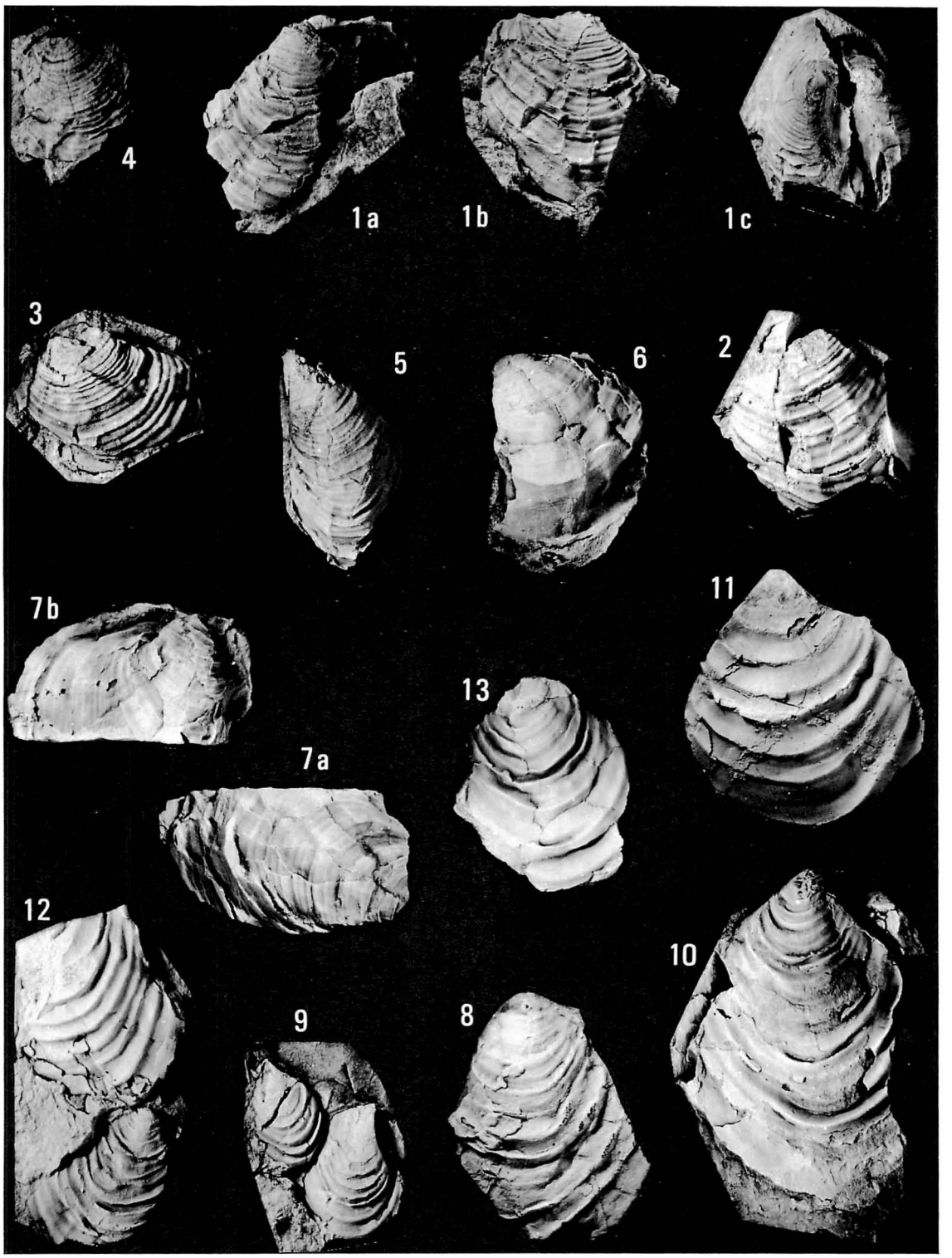
Fig. 9. Internal moulds of right and left valves (upper: MM5721; lower: MM5722), Loc. 42, Ketagawa, Matsuno-cho.

Fig. 10. Internal mould of right valve (MM5723), Loc. 5, Seizui, Hiromi-cho.

Fig. 11. Right internal mould (MM5724), Loc. 49, Matsumaru, Matsuno-cho.

Fig. 12. Internal moulds of two right valves (upper: MM5725; lower: MM5726), Loc. 43, Nojiri, Matsunocho.

Fig. 13. Right internal mould (MM5727), Loc. 33, Yakirai, Hiromi-cho.


4
1a
1b
1c
3
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6
2
7b
11
13
7a
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Trans. Proc. Palaeont. Soc. Japan, N.S., No. 120, pp. 419-448, pls. 51-53, December 30, 1980

723. EARLY CRETACEOUS BIVALVIA FROM THE CHOSHI DISTRICT, CHIBA PREFECTURE, JAPAN*

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Abstract. Barremian and early Aptian bivalve fossils from the Choshi Group of central Honshu are examined mainly on the basis of newly collected material as a companion work to the paper on the coexistent gastropod fossils (KASE and MAEDA, 1980). Most specimens belong to already named species from the Lower Cretaceous marine strata of Kwanto mountains and the Outer Zone of Southwest Japan, but their diagnostic characters became clearer owing to the excellent state of preser vation. The following fifteen species are described in this article: *Nuculopsis* (*Palaeonucula*) *ishidoensis*, *Portlandia sanchuensis*, *Mesosaccella* (?) *choshiensis* sp. nov., *Mesosaccella*(?) sp., *Solemya* sp., *Grammatodon* (*Nanonavis*) *yokoyamai*, *Pinna* (*Pinna*) sp., *Pterotrigonia* (*Pterotrigonia*) *pocilliformis*, *Astarte* (*Astarte*) *subsenecta*, *Laevicardium*(?) sp. aff. *L.* (?) *ishidoense*, *Rasatrix suzukii* sp. nov., *Caestocorbula shikamai* sp. nov., *Caestocorbula minima* sp. nov., *Corbulomima* sp. cf. *C. nuciformis* and *Plectomya aritagawana*. Taxonomic comments are also given to several other bivalves which are not represented in the present collection but have been recorded from the Choshi Group in some previous works.

Introduction

Since ISHIWATARI (1906) reported the occurrence of a trigoniid fossil [*Pterotrigonia*] from a quarry at Nagasaki of Choshi Peninsula, some Early Cretaceous bivalve fossils from the Choshi Group were identified and listed by several workers (YEHARA, 1914; YAMANE, 1924; etc.). YEHARA (1923) assigned several trigoniid specimens from this quarry to *Trigonia pocilliformis* YOKOYAMA, and this identification was again confirmed by TAMURA (1978a). MAEDA (1962) and HAYAMI (1965a, b) described several specimens of bivalves together with materials from other regions of Japan, proposing a few new species of *Nipponitrigonia* and *Isognomon* on the basis of Choshi specimens. SHIKAMA and SUZUKI (1972) listed and illustrated, though did not describe,

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a number of bivalve and other fossils at several localities in this peninsula.

Nevertheless, our knowledge of bivalve fauna from the Choshi Group remains still insufficient, because only a few descriptive works were published and because the preservation of fossils had generally been regarded as unfavorable. Recently, however, a calcareous bed containing numerous exceptionally well-preserved molluscan fossils was discovered at the coast of Kimigahama (Loc. 2 in this paper) about 1 km north of the Cape Inubo-zaki, Choshi City, by some students of the University of Tokyo including one of us (T. O.). As to the procedure of fossil hunting from this locality and the geological background, the reader is referred to the introductory notes and illustrations in a companion paper (KASE and MAEDA, 1980) on the gastropods, which appeared in the same journal. Some specimens, occurred at the coast of Nagasaki (Loc. 4) and Ashikajima (Locs. 7 and 8) of the Choshi Peninsula, are also worthy to describe, because the shell material, though sometimes abraded, is preserved in a fairly good condition.

Recent stratigraphic works of the Choshi Group were undertaken by SHIKAMA and SUZUKI (1972) and OBATA et al. (1975), and the geological background of various fossil beds became clear to a great extent. OBATA et al. (1975) contributed to the age determination and international correlation of this group on the basis of widely distributed ammonite species at several horizons. According to them it is known that the Choshi Group ranges from Barremian to lower Upper Aptian. However, a new question arose about the stratigraphy by the discovery of a Barremian ammonite, *Barremites* sp., in our collection at Loc. 2 (OBATA's personal communication), since the Kimigahama Formation involving this fossil locality apparently overlies the Ashikajima Formation, which has generally been considered as Lower Aptian. This must be solved by further field investigation.

In the present article fifteen bivalve species are described on the basis of newly collected materials. Many specimens actually belong to already named species from the Sanchu area of Kwanto mountains and the Outer Zone of Southwest Japan (western Kii Peninsula, Shikoku and Kyushu), but their specific characters became clearer by the excellent preservation of the present material. Four species of *Mesosaccella* (?), *Rasatrix* and *Caestocorbula* are described as new. The faunal characters are discussed, taking some other bivalves, which are not represented in the present collection but were illustrated in previous works, into consideration.

Locality guide

Loc. 1 [≒Loc. 04 in SHIKAMA and SUZUKI, 1972; ≒Loc. 7306 in OBATA et al., 1975; =Loc. 1 in KASE and MAEDA, 1980]

Location.—Coast of Isejigaura (35°43′13″N, 140°52′19″E).

Horizon and age.—Basal part of Isejigaura Formation. Barremian.

Lithology.—Dark grey sandy siltstone with calcareous concretions, in which fossils occur.

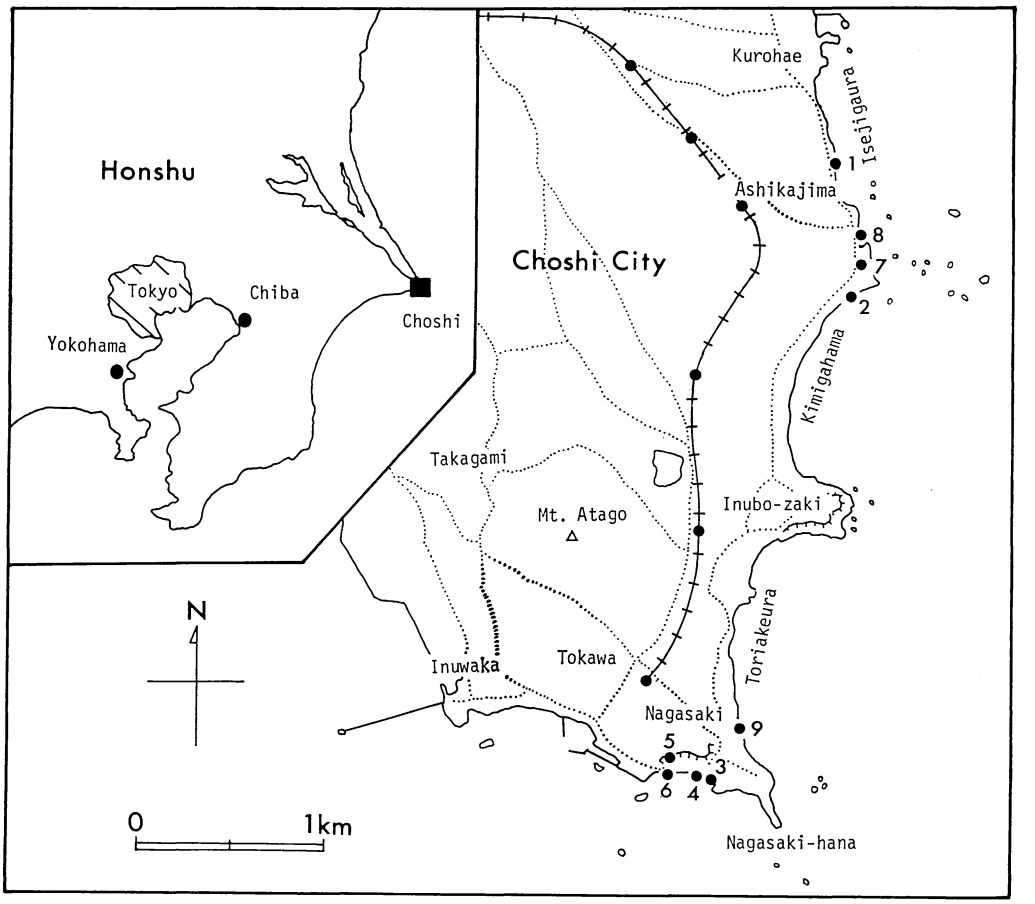
Fossils.—*Solemya* sp., *Amberleya* (*Eucyclus*) *japonica*, *Oolitica* sp., *Neohibolites*(?) sp., *Ptilophyllum pecten*.

Loc. 2 [=Loc. 09 in SHIKAMA and SUZUKI, 1972; =Loc. 7316 in OBATA et al., 1975; =Loc. 2 in KASE and MAEDA, 1980]

Location.—Northern coast of Kimigahama (35°42′54″N, 140°52′24″E).

Horizon and age.—Middle part of Kimigahama Formation. Barremian.

Lithology.—Alternation of grey fine-grained sandstone and dark grey siltstone in which a lens of fossiliferous grey calcareous sandstone is contained. Fossil bivalves



Text-fig. 1. Index map of the localities of Early Cretaceous bivalve fossils in the Choshi district.

well preserved and frequently articulated. Fine ornaments and spines of gastropods also well preserved. (see KASE and MAEDA, 1980)

Fossils.—[Fine-grained sandstone] *Nuculopsis* (*Palaeonucula*) *ishidoensis, Portlandia sanchuensis, Mesosaccella*(*?*) *choshiensis, Mesosaccella*(*?*) sp., *Pinna* (*Pinna*) sp., *Rasatrix suzukii, Caestocorbula minima, Corbulomima* sp. cf. *C. nuciformis.* [Siltstone] *Solemya* sp., *Grammatodon* (*Nanonavis*) *yokoyamai, Pterotrigonia* (*Pterotrigonia*) *pocilliformis, Laevicardium*(*?*) sp. aff. *L.*(*?*) *ishidoense, Caestocorbula shikamai, Plectomya aritagawana, Calliostoma*(*?*) *ojii, Ataphrus nipponicus, Hayamia rex, Hayamia choshiensis, Perissoptera elegans, Pietteia cretacea, Ceratosiphon densestriatus, Vanikoropsis decussata, Eriptycha japonica, Barremites* sp., Pulchellidae gen. and sp. indet., echinoid, asteroid, shark teeth, etc.

Loc. 3 [=Loc. 13 in SHIKAMA and SUZUKI, 1972; =Loc. 7028 in OBATA et al., 1975; =Loc. 3 in KASE and MAEDA, 1980]

Location.—Coast of Nagasaki harbor (now not exposed) (35°41′30″N, 140°51′54″E).

Horizon and age.—"Kimigahama Formation". Lower Aptian.

Lithology.—Dark grey calcareous sandy siltstone.

Fossils.—*Nuculosis* (*Palaeonucula*) *ishidoensis*, *Cucullaea transversa*, *Eonavicula*(?) sp., *Neithea* (*Neithea*) sp., *Neithea* (*Neithella*) *notabilis*, *Plicatula* sp., *Spondylus* sp., *Acesta*(?) sp., Limidae gen. and sp. indet., *Limatula nagaoi*, *Rastellum* (*Arctostrea*) *carinatum*, *Gryphaea* (*Bilobissa*?) sp., *Lopha* (*Actinostreon*) *nagaoi*, *Amphidonte* (*Ceratostreon*) *yabei*, *Amphidonte* (*Amphidonte*) *subhaliotoidea*, *Pachythaerus* sp., *Astarte* (*Yabea*) *shinanoensis*, *Opis*(?) sp., *Laevicardium*(?) sp. aff. *L.* (?) *ishidoense*, *Corbulomima* sp. cf. *C. nuciformis*, *Metriomphalus nagasakiensis*, etc. [Specific names revised on the basis of SHIKAMA and SUZUKI's (1972) illustrated specimens]

Loc. 4 [=Loc. 14 in SHIKAMA and SUZUKI, 1972]

Location.—Western coast of Nagasaki harbor (35°41′31″N, 140°51′51″E).

Horizon and age.—"Kimigahama Formation". Lower Aptian.

Lithology.—Massive grey fine-grained sandstone. Fossils more or less abraded.

Fossils.—*Nuculopsis* (*Palaeonucula*) *ishidoensis*, *Astarte* (*Astarte*) *subsenecta*, *Caestocorbula shikamai*, belemnoid.

Loc. 5 [≒Loc. 17 in SHIKAMA and SUZUKI, 1972; ≒Loc. 7332 in OBATA et al., 1975]

Location.—Western end of a quarry at the west of Nagasaki (Hatoyama) (35°41′34″N, 140°51′46″E).

Horizon and age.—"Kimigahama Formation". Lower Aptian.

Lithology.—Weathered massive fine- or medium-grained sandstone. Fossils represented by casts and moulds.

Fossils.—*Portlandia* (?) sp., *Pterotrigonia* (*Pterotrigonia*) *pocilliformis*, *Rasatrix suzukii*.

Loc. 6 [=Loc. 15 in SHIKAMA and SUZUKI, 1972; ≒Loc. 7231 in OBATA et al., 1975]

Location.—Eastern coast of Tokawa (35°41′31″N, 140°51′46″E).

Horizon and age.—"Kimigahama Formation". Lower Aptian.

Lithology.—Weathered coarse-grained sandstone.

Fossils.—*Laevicardium*(?) sp. aff. *L.* (?) *ishidoense*.

Loc. 7 [=Loc. 08 in SHIKAMA and SUZUKI, 1972]

Location.—Small hill at the south of Ashikajima (35°43′00″N, 140°52′24″E).

Horizon and age.—Ashikajima Formation. Barremian or Lower Aptian.

Lithology.—Massive grey medium-grained sandstone. Fossils generally well-preserved.

Fossils.—*Gervillia* (*Gervillia*) *forbesiana*, *Nipponitrigonia choshiensis*, *Pterotrigonia* (*Pterotrigonia*) *pocilliformis*, *Astarte* (*Astarte*) *subsenecta*, *Laevicardium*(?) sp. aff. *L.* (?) *ishidoense*, *Caestocorbula shikamai*.

Loc. 8 [=Loc. 07 in SHIKAMA and SUZUKI, 1972]

Location.—Bathing coast of Ashikajima (35°43′03″N, 140°52′24″E).

Horizon and age.—Ashikajima Formation. Barremian or Lower Aptian.

Lithology.—Massive grey medium-grained sandstone.

Fossils.—*Astarte* (*Astarte*) *subsenecta*.

Loc. 9 [=Loc. 12 in SHIKAMA and SUZUKI, 1972; ≒ Loc. 7125 in OBATA et al., 1975]

Location.—Coast of Toriakeura (35°41′39″N, 140°52′00″E).

Horizon and age.—Toriakeura Formation. Upper Aptian.

Lithology.—Dark grey sandy shale.

Fossils.—*Parvamussium* sp.

Systematic description

[by Itaru HAYAMI]

Superfamily Nuculacea GRAY, 1824

Family Nuculidae GRAY, 1824

Genus *Nuculopsis* GIRTY, 1911

Subgenus *Palaeonucula* QUENSTEDT, 1930

Nuculopsis (*Palaeonucula*) *ishidoensis* (YABE and NAGAO)

Plate 51, Figures 1-6

v. 1926. *Nucula ishidoensis* YABE and NAGAO, *in* YABE, NAGAO and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 11, no. 2, p. 41, pl. 13, figs. 46, 47.

v. 1965. *Nuculopsis* (*Palaeonucula*) *ishidoensis* (YABE and NAGAO) : HAYAMI, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 15, no. 2, p. 234.

v. cf. 1965. *Nuculopsis* (*Palaeonucula*) sp. cf. *N.* (*P.*) *ishidoensis* (YABE and NAGAO) : MATSUMOTO, HAYAMI and HASHIMOTO, *Petrol. Geol. Taiwan*, no. 4, p. 8, pl. 1, fig. 8.

v. 1972. *Nuculopsis* (*Palaeonucula*) *ishidoensis* (YABE and NAGAO) : SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 4, figs. 5, 6.

1975. *Nuculopsis* (*Palaeonucula*) *ishidoensis* (YABE and NAGAO) : HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 20.

Type.—Of the two original specimens of this species (IGPS no. 7125) from the Ishido Formation at Ishido, Ohinata village, Minami-saku County, Nagano Prefecture, a left internal mould (YABE, NAGAO and SHIMIZU, 1926, pl. 13, fig. 46) was designated by HAYAMI (1965a, p. 234) as the lectotype.

Material.—The following description is based on about 60 well preserved specimens (UMUT MM9701-9715) from Loc. 2 and about 15 specimens (UMUT MM9716, 9717) from Loc. 4.

Diagnosis.—Medium-sized and unornamented species of *Palaeonucula*, characterized by the suboval outline, strongly inflated and thick shell, smooth and shiny surface, prominent and opisthogyrous umbo and well delimited escutcheon. Hinge teeth consisting of about 19 anterior and about six posterior denticles, interrupted by a comparatively undeveloped chondrophore.

Description.—Shell nuculiform or suboval, scarcely exceeding 17 mm in maximum length and 13 mm in transverse height, highly inequilateral, strongly inflated ; umbo very prominent, rising highly above dorsal margin, opisthogyrous, located at about four-fifths of length from anterior end ; antero-dorsal margin long, nearly straight, obliquely truncated by anterior margin ; postero-dorsal margin comparatively short, forming an obtuse angle at posterior end ; apical angle between antero-dorsal and postero-dorsal margins about 95 degrees ; ventral margin gently arcuate ; postero-dorsal area (escutcheon) a little concave, heart-shaped, circumscribed by a small ridge extending from umbo to posterior angle ; surface shiny and smooth except for fine growth-lines ; inner ventral margin entirely smooth ; both adductor muscle scars strongly impressed ; anterior denticles number about 19, relatively strong and thick, while posterior ones are only about six and densely spaced ; chondrophore present but comparatively small ; umbonal cavity deep.

Remarks.—All of the type and subsequently collected specimens from the Ishido Formation of the Sanchu area are poorly preserved internal and external moulds. The newly collected specimens from the Choshi Group have nearly complete tests and are not deformed, exhibiting well the external characters. The smooth inner ventral margin is well recognized by the four inarticulated specimens (MM9705, 9706, 9713, 9714). The hinge structure is, though incompletely shown, also observable in them, but more clearly in an incomplete specimen (MM9716) and a left internal mould (MM9711), the test of which was dissolved with diluted HCl. The hinge and other internal structures of these specimens, particularly the shape and numbers of anterior and posterior denticles, agree well with those of

Table 1. Measurements in mm [*Nuculopsis* (*Palaeonucula*) *ishidoensis* (YABE and NAGAO)]

Specimen	Length	Height	Thickness
Conjoined valves (MM 9701)	14.7	11.2	9.0
Right valve (MM 9702)	14.6	11.9	4.6
Right valve (MM 9703)	13.0	10.8	4.3
Right valve (MM 9704)	10.8	8.2	3.1
Right valve (MM 9705)	16.0	12.1	5.1
Conjoined valves (MM 9707)	15.6	11.8	10.0
Left valve (MM 9709)	13.6	11.1	4.5
Conjoined valves (MM 9710)	16.1	12.0	8.9
Left valve (MM 9713)	14.4	11.2	4.3
Right valve (MM 9714)	15.0	12.1	5.0

Form ratio (Length/Height) N=10, $\bar{x}$=1.280, s=0.051, V=3.953, O.R.=1.204-1.342

the lectotype and paralectotype specimens. The position of umbo appears to be located more posteriorly in the lectotype and paralectotype, but it may be due to their secondary deformation.

As noted by COX (1940) and some others, it may be difficult to draw a sharp boundary between *Palaeonucula* QUENSTEDT, 1930 (commonly treated as a subgenus of *Nucula* or *Nuculopsis* or a distinct genus) and *Leionucula* QUENSTEDT, 1930 (a subgenus of *Nucula*). *Palaeonucula*, mainly from the Triassic and Jurassic, seems generally to have more posteriorly located umbo, more reduced posterior denticles, and more trapezoidal and strongly inflated outline than *Leionucula* from the Cretaceous. As stated before (HAYAMI, 1965a), the suboval outline and some other characteristics of the present species may be transitional between *Palaeonucula* and *Leionucula*.

The present species actually resembles *Nucula albensis* D'ORBIGNY, 1844, the type-species of *Leionucula*, from the Gault of England (WOODS, 1899) in the suboval outline and clearly impressed escutcheon. There is, however, some uncertainty about the specific characters of *N. albensis*, because D'ORBIGNY's type material has not been restudied, and because the Gault specimens illustrated by GARDNER (1884) and WOODS (1899) show an unusually wide range of morphologic variation. The present specimens differ from any Gault specimen in the stronger shell convexity and more posteriorly located umbo. *Nucula planata* DESHAYES, 1842, from the Speeton Clay and Lower Greensand of England (WOODS, 1899) may be also a comparable species, but it has decidedly less prominent umbo and more weakly inflated shell and is probably referable to *Leionucula*. *Leionucula olivensis* VOKES, 1946, from the Aptian of Lebanon, shows less prominent umbo and larger apical angle than the present species.

In the strongly inflated and thick shell and much reduced posterior denticles the present species seems to be more closely related to some Jurassic and early Cretaceous species of *Palaeonucula* than to above compared species of *Leionucula*. Although the stratigraphic range of *Palaeonucula* is said to be confined to the Triassic and Jurassic (MCALESTER *in* COX et al., 1969), *Nucula glanstriticea* WHITFIELD, 1891, from the Aptian of Lebanon, is undoubtedly referable to *Palaeonucula*, as treated by VOKES (1946). The present species, which differs from the Lebanon species in the smooth and shiny surface, seems to be another representative of this subgenus.

Occurrence.—Very common at Loc. 2 and common at Locs. 3 and 4. This spe-

cies is also known from the Ishido Formation at Ishido, Ohinata village, Nagano Prefecture (type locality), from the Arida (=Arita) Formation in the Yuasa area of Wakayama Prefecture, and from the Hanoura Formation at Hiroyasu, Katsuura town, Tokushima Prefecture. Upper Neocomian to Lower Aptian.

Superfamily Nuculanacea ADAMS and ADAMS, 1858

Family Nuculanidae ADAMS and ADAMS, 1858

Genus *Portlandia* MÖRCH, 1857

Portlandia sanchuensis (YABE and NAGAO)

Plate 51, Figures 7-10

v. 1926. *Nuculana sanchuensis* YABE and NAGAO, *in* YABE, NAGAO and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 11, no. 2, p. 42, pl. 12, figs. 21-23.

v. 1965. *Nuculana* (s. l.) *sanchuensis* YABE and NAGAO: HAYAMI, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 15, no. 2, p. 235.

v. non 1972. *Nuculana* (s. l.) sp. cf. *N. sanchuensis* YABE and NAGAO: SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 4, fig. 3.

Type.—Of the three original specimens of this species (IGPS no. 7115) from the Ishido Formation at Ishido, Ohinata village, Minami-saku County, Nagano Prefecture, a right internal mould (YABE, NAGAO and SHIMIZU, 1926, pl. 12, fig. 21) was designated by HAYAMI (1965a, p. 235) as the lectotype.

Material.—The following description is based on four specimens (UMUT MM9718-9721) at Loc. 2.

Diagnosis.—Small- or medium-sized species of *Portlandia*, characterized by the rostrated and flattened posterior area, broad and orthogyrous umbo and numerous fine concentric striae which are restricted to the median portion of valves.

Description.—Shell small or medium for thegenus, rarely exceeding 17mm in length, elongate ovate, inequilateral, moderately inflated; test comparatively thin; antero-dorsal margin nearly straight, gradually bending down to rounded anterior margin; postero-dorsal margin long and broadly concave, somewhat abruptly turned to posterior margin at rostrated posterior end; ventral margin smoothly arcuate; umbo broad, not prominent, orthogyrous, situated a little anteriorly from mid-length; escutcheon not clearly demarcated; surface of middle portion of valve ornamented by numerous delicate concentric striae, which are abruptly effaced toward anterior and posterior sides; anterior and posterior areas quite smooth except for growth-lines, occupying nearly the same width as median ornamented area; muscle scars very weakly impressed; chondrophore present but hinge structure exactly unknown.

Remarks.—The outline and surface characters are best shown in a nearly complete right valve (MM9718). The concentric striae restricted to the middle portion are also recognized in an incomplete left valve (MM9720). Another specimen (MM9721) reveals the interior of a right valve. The

Table 2. Measurements in mm [*Portlandia sanchuensis* (YABE and NAGAO)]

Specimen	Length	Height	Thickness
Right valve (MM 9718)	15.9	9.1	3.8
Right in. mould (MM 9719)	16.6	9.3	3.4+
Left valve (MM 9720)	16.0+	10.0	4.1
Right valve (MM 9721)	14.6	8.3	?

presence of chondrophore is ascertained in this specimen, but the hinge teeth are concealed by the matrix.

All of the type specimens of *Nuculana sanchuensis* are poorly preserved, and the surface characters of this species has been imperfectly known. However, the present specimens are certainly referable to this species, because their outline is quite identical with that of the lectotype and paralectotypes. *Nuculana* (s. l.) sp. cf. *N. sanchuensis* from the Choshi Group at a quarry of Nagasaki, which was illustratad by SHIKAMA and SUZUKI (1972), probably belongs to a different species, because the shell is much shorter.

Judging from the rostrated but not much tapered posterior area and other external characters, the present species, as suggested previously (HAYAMI, 1965a), seems to be more appropriately regarded as an early representative of *Portlandia* rather than *Nuculana*. ICHIKAWA and MAEDA (1958b) already described several Upper Cretaceous species of *Portlandia* from Southwest Japan, and the present species indicates that the record of this genus goes back to the Barremian.

The present species resembles *Portlandia izumensis* ICHIKAWA and MAEDA, 1958b, from the Upper Cretaceous Izumi Group of the Kii Peninsula and Awaji Island, but differs from it in having broader umbonal area. It is distinguishable from many species of *Portlandia* by the concentric striae restricted to the middle portion of valves. This character may remind one of that of the genus *Borissia* SLODKEVICH, 1938, but the resemblance may be superficial, since such a restricted ornaments are also known in some other nuculanid genera.

Occurrence.—Rare at Loc. 2. This species is also known from the Ishido Formation at Ishido, Ohinata village, Nagano Prefecture, and at Shiroi and south of Kagahara, Nakazato village, Gumma Prefecture, from the Hanoura Formation at the east of Nakagoya, Katsuura town, Tokushima Prefecture, from the Arida (=Arita) Formation at Suhara, Yuasa town, Wakayama Prefecture, and also from the Yatsushiro Formation at the southwest of Kohara, Toyo village, Kumamoto Prefecture.

Family Malletiidae ADAMS and ADAMS, 1858

Genus *Mesosaccella* CHAVAN, 1946

Mesosaccella (?) *choshiensis* HAYAMI, sp. nov.

Plate 51, Figures 11, 12

Type.—The holotype (UMUT MM9722) is an articulated specimen from Loc. 2, on which the following description is based. The paratype (MM9723) is a left valve from the same locality.

Diagnosis.—Small-sized nuculanid characterized by elongate-rhomboidal and *Saccella*-like outline, submesially placed umbo, narrow and weakly impressed escutcheon and comparatively weak concentric striae on the umbonal-middle portion of valves.

Description.—Shell small, transversely elongated, rounded rhomboidal, moderately inflated, lenticular in dorsal view; antero- and postero-dorsal margins nearly straight, subequal in length, forming an apical angle of about 130 degrees; anterior margin rounded, while posterior end of shell is bluntly pointed; umbo not prominent but pointed, placed near mid-length of valve; escutcheon narrow, delimited by a shallow sulcus extending from umbo to posterior end; surface unornamented except for umbonal-middle portion of valves, where a large number of faint concentric striae are developed; internal characters unknown.

Table 3. Measurements in mm [*Mesosaccella*(?) *choshiensis* HAYAMI, sp. nov.]

Specimen	Length	Height	Thickness
Holotype conjoined valves (MM 9722)	11.9	6.8	4.6
Paratype left valve (MM 9723)	13.5	7.7	2.7

Remarks.—The holotype is an articulated specimen, from which the matrix was completely removed. Although the umbonal area of its right valve is broken, the external characters are well shown. Because of the ignorance of hinge and ligament structure, the generic assignment of this species is by no means certain, but the *Saccella*-like outline seems to suggest its tentative reference to *Mesosaccella*. It is, in fact, similar to *Nuculana mariae* (D'ORBIGNY) from the Gault of England (WOODS, 1899) and *Nuculana lineata* (SOWERBY) from the Lower Greensand of England (WOODS, 1899), both of which are regarded as belonging to *Mesosaccella*. The present species, however, is different from the two species in the nearly straight postero-dorsal margin, less conspicuous concentric striae and mesially placed umbo. It is also similar to *Mesosoccella insignis* (NAGAO, 1934) from the Upper Aptian to Lower Albian Miyako Group in north Honshu (HAYAMI, 1965a), but differs from that species in the less developed concentric striae and less sharply pointed posterior end. It is distinguishable from *Mesosaccella* (?) *taiwanensis* HAYAMI *in* MATSUMOTO, HAYAMI and HASHIMOTO (1965) from the buried Aptian of west Taiwan by the narrower outline and stronger shell convexity.

Occurrence.—Known only from Loc. 2.

Mesosaccella (?) sp. indet.

Plate 51, Figures 13, 14

This species is represented by a left valve (UMUT MM9784, 6.5 mm long, 4.0 mm high, 1.3 mm thick) and a right valve (MM9785, 7.6 mm long, 4.8 mm high, 1.5 mm thick). It is somewhat similar to the preceding species, *Mesosaccella* (?) *choshiensis* sp. nov., in the subrhomboidal outline, but the shell is much smaller and somewhat shorter, and the umbonal surface lacks any concentric ornamentation.

Occurrence.—Known only from Loc. 2.

Superfamily Solemyacea ADAMS and ADAMS, 1857

Family Solemyidae ADAMS and ADAMS, 1857

Genus *Solemya* LAMARCK, 1818

Solemya sp. indet.

Plate 51, Figures 15-17

Six specimens (UMUT MM9725-9730) are available for this study, but all of them are incomplete or secondarily deformed. The test is partly preserved in two relatively large specimens (MM9725, 9726), and other specimens are internal moulds.

Shell medium-sized for this genus, transversely elongated with rounded anterior and posterior margins, moderately inflated; ventral margin subparallel to dorsal margin, long; umbo placed very posteriorly; surface marked with more than 12 subequidistant radial grooves which are much narrower than their interspaces; ligament structure unknown.

The present species somewhat resembles *Solemya angusticaudata* NAGAO, 1932, from the Upper Cretaceous of Hokkaido in the

oblong outline, but the radial grooves seem to be more widely spaced. Their specific determination is now difficult, because the material is too insufficient to recognize the diagnostic characters.

Occurrence.—Rare at Loc. 1 and Loc. 2.

Superfamily Arcacea LAMARCK, 1809

Family Parallelodontidae DALL, 1898

Subfamily Grammatodontinae BRANSON, 1942

Genus *Grammatodon* MEEK and HAYDEN, 1861

Subgenus *Nanonavis* STEWART, 1930

Grammatodon (Nanonavis) yokoyamai YABE and NAGAO

Plate 52, Figures 1-6

1890. *Cucullaea* cf. *striatella* MICHELIN : YOKOYAMA, *Palaeontographica*, Bd. 36, p. 199, pl. 25, fig. 13.

v. 1926. *Gammatodon* [sic] *yokoyamai* YABE and NAGAO, *in* YABE, NAGAO and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 9, no. 2, p. 44, pl. 12, figs. 12, 13, 25.

1963. *Nanonavis yokoyamai* (YABE and NAGAO) : MATSUMOTO, HAYAMI and ASANO, A Survey of Fossils from Japan Illustrated in Classical Monographs, p. 32, pl. 51, fig. 13.

v. 1965. *Nanonavis (Nanonavis) yokoyamai* (YABE and NAGAO) : HAYAMI, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 15, no. 2, p. 238, pl. 27, figs. 8-13.

v. 1965. *Nanonavis (Nanonavis)* sp. cf. *N. (N.) yokoyamai* (YABE and NAGAO) : HAYAMI, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 15, no. 2, p. 241, pl. 27, fig. 14.

v. 1972. *Nanonavis (Nanonavis) yokoyamai* (YABE and NAGAO) : SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, ser. 2, no. 19, pl. 4, fig. 7.

1975. *Grammatodon (Nanonavis) yokoyamai* YABE and NAGAO : HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 29.

1976. *Nanonavis yokoyamai* (YABE and NAGAO) : TASHIRO, *Pal. Soc. Japan, Spec. Pap.*, no. 19, p. 44, text-fig. 15A.

Type.—Of the three original specimens of this species (IGPS no. 22555) from the Ishido Formation at Ishido, Ohinata village, Nagano Prefecture, an internal mould of articulated valves (YABE, NAGAO and SHIMIZU, 1926, pl. 12, figs. 12, 12a) was designated by HAYAMI (1965a, p. 238) as the lectotype.

Material.—The following description is based on 55 specimens (UMUT MM9731-9742) at Loc. 2.

Diagnosis.—Small-sized, strongly inflated and trapezoidal species of *Nanonavis* with slightly larger left valve, characterized by the sharp and non-serrated posterior carina, wide posterior area, and weak radial ribs which are simple in the left valve but composed of two orders of prominence in the right, becoming stronger and more widely spaced towards the anterior.

Description.—Shell small for the subgenus, scarcely exceeding 40 mm in length, slightly inequivalve, subtrapezoidal, about 1.7 times longer than high, strongly inflated in full grown stage; test moderate in thickness; left valve larger than right, with ventral margin overlapping that of right valve; dorsal margin long and straight, extending nearly over total length; anterior margin rounded, forming an angle of 70 to 80 degrees with dorsal margin; posterior margin slightly convex, forming an obtuse angle of 100 to 110 degrees with dorsal margin; umbo rising highly above dorsal margin, prosogyrous, situated at about one-third of hinge-line from frontal end; a sharp carina stretching from umbo to postero-ventral angle, defining a concave posterior area; left valve ornamented with about 35 narrow

radial ribs which are generally weak on posterior and middle areas but become stronger and more widely spaced towards anterior end; right valve also ornamented with radial ribs of similar number, but each of their interspaces marked with one or two much weaker subordinate radial riblets; cardinal area variable in breadth but comparatively wide in full-grown stage, bearing a number of chevron-shaped ligament grooves; hinge teeth typical of *Nanonavis*, convergent to a point below umbo, consisting of several prosoclinal anterior teeth and about three elongated subhorizontal posterior teeth in each valve; inner ventral margin smooth without crenulation.

Table 4. Measurements in mm [*Grammatodon* (*Nanonavis*) *yokoyamai* YABE and NAGAO]

Specimen	Length	Height	Thickness
Conjoined valves (MM 9731)	32.3	20.6	19.0
Conjoined valves (MM 9732)	38.0	21.7	22.6
Left valve (MM 9733)	33.0	18.9	10.0
Left valve (MM 9734)	35.8	21.0	11.4
Left valve (MM 9735)	34.9	20.0	9.9
Right valve (MM 9735)	32.1+	19.7	10.3
Left valve (MM 9736)	34.8	21.7	10.5
Right valve (MM 9736)	34.8	20.1	10.7
Right valve (MM 9737)	31.0+	20.1	?
Conjoined valves (MM 9738)	34.6	20.6	21.7
Right in. mould (MM 9739)	33.2	20.2	10.7+

Form ratio of left valve (Length/Height) N =7, $\bar{x}$=1.686, s=0.073, V=4.330, O.R.=1.568 −1.751

Remarks.—Most of the specimens available for this study are open or closed articulate individuals. Their tests are well preserved, and the surface ornamentation is well exhibited. The unequal shell size between two valves is observed in three closed specimens (MM9731, 9732, 9738), in which the ventral margin of left valve overlaps that of right valve. The different surface ornamentation between two valves are recognized in many articulated specimens; the right valve has always finer radial ribs which are of two orders of prominence. In some specimens the posterior area is further divided into two subequal areas by an indistinct median carina, which becomes obsolete toward the posterior margin. The hinge structure is observable only in two internal moulds (MM9739, 9740), the test of which were artificially dissolved by diluted HCl. In some larger specimens (e. g. MM9732) the umbones are widely separated by broad cardinal areas, and the ventral peripheral areas of two valves are nearly vertical to the commissure plane and marked with dense and somewhat rugose growth-lines. Analogy with the allometric growth in some living species of the Anadarinae seems to indicate that these are characteristic features of the full-grown stage.

The present species was fully described by YABE and NAGAO in YABE, NAGAO and SHIMIZU (1926) and HAYAMI (1965a). However, the material treated in these works was mostly internal and external moulds of inarticulate valves, and the degree of inequivalveness and the different mode of radial ribs were not recognized on a firm basis.

The unequal size and ornamentation between two valves of the present species remind one of the diagnostic characters of *Indogrammatodon* COX, 1937, whereas the shell outline, especially the sharp posterior carina, is essentially similar to

Grammatodon carinatus (SOWERBY, 1813) from the Lower Greensand and Gault of England (WOODS, 1899; etc.) which is the type-species of *Nanonavis*. So far as I am aware, unequal ornamentation has not been recorded in *G. carinatus*, but *Grammatodon securis* (LEYMERIE, 1842) from the Speeton Clay (WOODS, 1899, pl. 7, fig. 14a, b), which may be closely related to *G. carinatus*, has fine radial ribs of two orders on the right (not left) valve just as the present species. So far as I observed several articulated specimens of *G. carinatus* preserved in the University Museum, University of Tokyo, the ventral margin of left valve scarcely overlaps that of right, suggesting that the shell is completely or nearly equivalve. Therefore, as suggested before (HAYAMI, 1965a), the present species as well as *G. securis* looks at a glance intermediate between *Nanonavis* and *Indogrammatodon*. In living species of *Anadara*, especially its subgenus *Scapharca*, however, the degree of inequivalveness (size and ornamentation) is different from species to species and regarded as changeable within an infrageneric group. This character is presumably related to the difference in the mode of life. In Japan, ICHIKAWA and MAEDA (1958a) regarded an Uppermost Cretaceous species having inequivalve shells as belonging to *Indogrammatodon*, but, as treated by TASHIRO (1976), it seems to be more closely related to some Upper Cretaceous species of *Nanonavis* than Jurassic species of *Indogrammatodon*. I think that unequal size and ornamentation between two valves may be actually a wide-spread feature not only in *Indogrammatodon* but also in *Nanonavis* and *Cucullaea*.

As noted above, the present species closely resembles *Grammatodon* (*Nanonavis*) *carinatus* and *G.* (*N.*) *securis* from the Lower Cretaceous of western Europe, but it is decidedly different from them in the much weakened radial ribs on the middle and posterior areas. The posterior carina is often finely serrated in the two European species, but such a tendency has not been observed in the present species. Comparisons between the present species and some Upper Cretaceous species of *Nanonavis* from Japan and Saghalien were already discussed by HAYAMI (1965a) and TASHIRO (1976).

Occurrence.—Common at Loc. 2. This species occurs from the Aridan and Miyakoan (upper Neocomian to Albian) strata at various localities in Japan (see HAYAMI, 1965a, p. 241, for the detail).

Superfamily Pinnacea LEACH, 1819

Family Pinnidae LEACH, 1819

Genus *Pinna* LINNAEUS, 1758

Subgenus *Pinna* LINNAEUS, 1758

Pinna (*Pinna*) sp. indet.

Plate 51, Figure 18

v. 1972. *Pinna* sp. cf. *P. robinaldina* D'ORBIGNY: SHIKAMA and SUZUKI, *Sci Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 4, fig. 11.

The present species is represented here by an articulate but incomplete specimen (UMUT MM9743) from the Kimigahama Formation at Loc. 2. It is 70.0 mm long, 24.6 mm wide and 10.7 mm thick, showing an angulated median ridge and about ten fine radial riblets on each slope. These characters agree well with the specimen from the same or adjacent locality of Kimigahama which was illustrated by SHIKAMA and SUZUKI (1972) as *Pinna* sp. cf. *P. robinaldina*. If compared with *Pinna robinaldina* D'ORBIGNY, 1844, from the Aptian and Albian of western Europe (WOODS, 1905-1906; etc.) and *Pinna* sp.

cf. *P. robinaldina* from the Barremian Ishido Formation and the Aptian Hinagu Formation in Japan (HAYAMI, 1965a), the shell is much smaller and the radial ribs are much weaker, although the present and SHIKAMA and SUZUKI's specimens may be immature.

Occurrence.—Rare at Loc. 2.

Superfamily Trigoniacea LAMARCK, 1819

Family Trigoniidae LAMARCK, 1819

Subfamily Pterotrigoniinae VAN HOEPEN, 1929

Genus *Pterotrigonia* VAN HOEPEN, 1929

Subgenus *Pterotrigonia* VAN HOEPEN, 1929

Pterotrigonia (*Pterotrigonia*) *pocilliformis* (YOKOYAMA)

Plate 52, Figure 7

Synonymy.—Only illustrated specimens of this species from the Choshi Group are listed below [see HAYAMI (1975, p. 117) and TAMURA' (1978a) revision for the full synonymy].

1906. *Trigonia* sp., ISHIWATARI, *Jour. Geol. Soc. Tokyo*, vol. 13, p. 216.

1923. *Trigonia pocilliformis* YOKOYAMA: YEHARA, *Japan. Jour. Geol. Geogr.*, vol. 2, p. 71, pl. 10, fig. 4.

1978. *Pterotrigonia* (*Pterotrigonia*) *pocilliformis* (YOKOYAMA): TAMURA, *Mem. Fac. Educ. Kumamoto Univ.*, no. 27, p. 91, pl. 3, figs. 12, 13.

Remarks.—Recently TAMURA (1978a) discussed the relation and distinction between *Pterotrigonia* (*Pterotrigonia*) *hokkaidoana* (YEHARA) and other related species of *Pterotrigonia* in Japan. A large number of specimens illustrated by TAMURA (1978a, pl. 3, figs. 1-15; 1978b, pl. 1, figs. 10, 11) should be added to the synonymy of *P.* (*P.*) *pocilliformis* given by HAYAMI (1975). As clarified by TAMURA, *P.* (*P.*) *hokkaidoana* seems to be distinguishable from *P.* (*P.*) *pocilliformis* by the larger and broader shell and more abruptly broadened posterior area in the late stage of growth.

From the Choshi Group, ISHIWATARI (1906) first reported the occurrence of a trigoniid from a quarry of Nagasaki, which is, as treated by YEHARA, referable to *P.* (*P.*) *pocilliformis*. Since then, a considerable number of specimens of *Pterotrigonia* were collected by geologists and amateurs at several localities in the Choshi Peninsula. So far as I am aware, all the specimens from this group including illustrated ones by YEHARA (1923) and TAMURA (1978a) show narrowly rostrated outline and seem to belong to *P.* (*P.*) *pocilliformis* instead of *P.* (*P.*) *hokkaidoana*. The present specimens (UMUT MM9770-9782) collected at Loc. 2 and Loc. 5 are also certainly referable to *P.* (*P.*) *pocilliformis*.

Occurrence.—Common at Locs. 2, 5 and 7. This species occurs very commonly from the Upper Neocomian to Albian deposits at various localities in Japan (see NAKANO, 1960; HAYAMI, 1975; TAMURA, 1978a).

Superfamily Crassatellacea FÉRUSSAC, 1822

Family Astartidae D'ORBIGNY, 1844

Subfamily Astartinae D'ORBIGNY, 1844

Genus *Astarte* J. SOWERBY, 1816

Subgenus *Astarte* J. SOWERBY, 1816

Astarte (*Astarte*) *subsenecta* YABE and NAGAO

Plate 53, Figures 1-6

v. 1926. *Astarte subsenecta* YABE and NAGAO, *in* YABE, NAGAO and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 9, pt. 3, p. 57, pl. 13, figs. 14-16, pl. 14, fig. 11.

v. 1926. *Astarte subsenecta* var. *costata* YABE and NAGAO, *in* YABE, NAGAO and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 9, pt. 3, p. 48, pl. 14, fig. 10.

v. 1965. *Astarte* (*Astarte*) *subsenecta* YABE and NAGAO: HAYAMI, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 17, no. 2, p. 81, pl. 7, figs. 10-18, pl. 14, figs. 1-5.

v. 1965. *Astarte* (*Astarte*) sp. cf. *A.* (*A.*) *subsenecta* YABE and NAGAO: HAYAMI, *Mem. Fac. Sci. Kynshu Univ.*, ser. D, vol. 17, no. 2, p. 84, pl. 11, figs. 9, 10.

v. 1965. *Astarte* (*Astarte*) *costata* YABE and NAGAO: HAYAMI, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 17, no. 2, p. 85, pl. 8, figs. 1, 2.

v. non 1972. *Astarte* (*Astarte*) *subsenecta* YABE and NAGAO: SHIKAMA and SHIMIZU, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 6, fig. 4. [probably an undescribed species of *Pachythaerus*]

v. 1972. *Astarte* (*Astarte*) *costata* YABE and NAGAO: SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 6, fig. 5.

v. 1975. *Astarte* (*Astarte*) *subsenecta* YABE and NAGAO: HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 125, pl. 6, figs. 3, 4.

1975. *Astarte* (*Astarte*) *costata* YABE and NAGAO: HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 125.

Type.—Of the four illustrated original specimens of this species (IGPS no. 22534) a right external mould from the Ishido Formation at Ishido, Ohinata village, Minami-saku County, Nagano Prefecture (YABE, NAGAO and SHIMIZU, 1926, pl. 14, fig. 11) was designated by HAYAMI (1965b, p. 82) as the lectotype. YABE, NAGAO and SHIMIZU (1926, pl. 14, fig. 10) illustrated another external mould of left valve (IGPS no. 22483) under the name of *Astarte subsenecta* var. *costata*. This specimen was generally regarded as the "holotype" of this variety. It is, however, clear from the original description that this variety was described on the basis of two or more specimens, and HANZAWA, ASANO and TAKAI's (1961) procedure is here interpreted to constitute the first and valid designation of the lectotype of var. *costata*.

Material.—The following description is based on 12 specimens (UMUT MM9744-9752) from Loc. 4 and Loc. 7.

Diagnosis.—Medium-sized species of *Astarte* (s. s.) characterized by trigonally ovate and not strongly inflated shell, well delimited siphonal margin, and concentric ribs of variable prominence which commonly become weaker with growth. Ventral margin rounded and internally crenulated only in adult stage. Hinge typical of *Astarte* (s. s.), with relatively low cardinal teeth having fine transverse striae on lateral sides.

Description.—Shell medium in size, scarcely exceeding 22 mm in length and 20 mm in height, inequilateral, trigonally ovate, more or less longer than high, not strongly inflated; test moderate in thickness; umbo pointed, prosogyrous, located at about two-fifths of length from front; antero-dorsal margin slightly concave, moderate in length; postero-dorsal margin gently arcuate, longer than antero-dorsal; siphonal (posterior) margin well delimited, forming obtuse angles with postero-dorsal and ventral margins; lunule and escutcheon comparatively narrow, defined by a blunt ridge, respectively; a blunt carina running from umbo to postero-ventral corner, obscurely defining posterior area; surface ornamented with widely spaced concentric ribs of variable prominence, which are sometimes persistent but more commonly became weaker with growth; ventral margin rounded and internally crenulated in adult stage, while it is

Table 5. Measurements in mm [*Astarte* (*Astarte*) *subsenecta* YABE and NAGAO]

Specimen	Length	Height	Thickness
Right valve (MM 9744)	19.0	18.7	ca. 6.0
Right valve (MM 9745)	18.4	17.2	6.4
Right valve (MM 9746)	19.9	18.8	ca. 6.5
Right valve (MM 9747)	19.7	19.3	5.1
Right valve (MM 9748)	11.3	9.6	ca. 3.0
Right valve (MM 9749)	20.0	18.1	5.7
Conjoined valves (MM 9750)	18.6	17.4	8.6
Conjoined valves (MM 9751)	19.7	19.3	9.8

Form ratio (Length/Height) N=8, $\bar{x}$=1.067, s=0.054, V=5.069, O.R.=1.016—1.177

sharply edged and not crenulated in immature stage; umbonal cavity shallow. Detailed hinge and muscle structures not observable in the present material.

Remarks.—All the specimens in the present collection have well preserved tests and reveal the external characters, but the hinge structure is only partly exposed in three right valves (MM9745-9747). The development of concentric ribs is quite variable in prominence and persistence; they are sometimes persistent throughout the growth (e. g. MM9744) but occasionally restricted to the umbonal area (e. g. MM9745). Furthermore, the surface is nearly smooth except for growth-lamellae throughout the growth in a few specimens (e. g. MM9746). As shown in a right valve (MM9747), the ventral margin is sharply edged and not crenulated internally. From the analogy with some living species of *Astarte*, these are regarded as characteristic of immature growth stage. As recognized in many specimens regarded as adult, the convexity of shell becames stronger near the ventral margin and fine internal crenulations are developed on the rounded edge (e. g. MM9787).

Such a wide range of morphological variation and remarkable ontogenetic change seem to have lead the identification of the present species astray. When YABE and NAGAO *in* YABE, NAGAO and SHIMIZU (1926) described *Astarte subsenecta* from the Ishido Formation at Ishido of the Sanchu area, a few specimens having persistent concentric ribs from the "Kawarazawa Formation" at Kawarazawa of the same area were named *A. subsenecta* var. *costata*. All the original specimens of *A. subsenecta* including this variety are poorly preserved and secondarily deformed. The detailed characters of this species, especially the hinge and other internal characters, were subsequently described by HAYAMI (1965b) on the basis of better preserved specimens from the Ishido Formation at the south of Kagahara of the Sanshu area. On that occasion the variety *costata* was interpreted with a query to constitute a distinct species for the reason that the concentric ribs are more persistent and the shell convexity is weaker than typical specimens of *A. subsenecta*. As described above, however, these characters do not seem to constitute any specific criteria.

Although further studies on the topotype specimens of this variety may be desirable, it is here concluded that the variety *costata* is taxonomically indistinguishable from *A.* (*A.*) *subsenecta*, because almost all the intermediate specimens are represented in the fossil samples at the present localities and the south of Kagahara (Loc. Hy. 4003 in HAYAMI, 1965b). The two illustrated specimens of *A.* (*A.*) *costata* in HAYAMI (1965b, pl. 8, figs. 1, 2) from the Ishido Formation at the south of Kagahara and the Choshi Group at

Ashikajima of Choshi are most certainly immature individuals of *A.* (*A.*) *subsenecta*.

Occurrence.—Common at Locs. 4, 7 and 8. This species occurs commonly from the Aridan to upper Miyakoan (upper Neocomian to Albian) strata at various localities in Japan (see HAYAMI, 1965b, pp. 84-86, for the detail).

Superfamily Cardiacea LAMARCK, 1809

Family Cardiidae LAMARCK, 1809

Subfamily Laevicardiinae KEEN, 1936

Genus *Laevicardium* SWAINSON, 1840

Laevicardium (?) sp. aff. *L.* (?) *ishidoense* (YABE and NAGAO)

Plate 53, Figure 7

v. 1972. *Nemocardium yatsushiroense* HAYAMI : SHIKAMA and SUZUKI, *Sci Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 6, fig. 9.

v. 1972. *Laevicardium*? *ishidoense* HAYAMI : SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 6, fig. 10.

1978. *Laevicardium* (?) *ishidoense* (YABE and NAGAO) : KATTO and TASHIRO, *Res. Rep. Kochi Univ.*, vol. 27, Nat. Sci., p. 146, pl. 1, figs. 12-15.

The present species is here represented by two specimens. One of them (UMUT MM9769, 28.3+mm long, 26.0+mm high, 11.0+mm thick) consists of incomplete internal and external moulds of a left valve, and the other (MM9770, 35.2+mm long, 35.0+mm high, 16.0+mm thick) is a broken left internal mould. The test is partly preserved on the internal moulds, but mostly exfoliated or artificially dissolved away.

The original shell is probably higher than long and strongly inflated. The surface is wholly ornamented with more than 130 delicate radial riblets, which become somewhat weaker towards the anterior and posterior peripheral areas. In the outline as well as mode of radial ornamentation the present species is identical with *Laevicardium* (?) *ishidoense* by KATTO and TASHIRO (1978) from the Doganaro Formation of Shikoku. If compared with typical specimens of that species from the Ishido Formation (YABE, NAGAO and SHIMIZU, 1926) and the Yatsushiro Formation (HAYAMI, 1965b), however, the shell is larger and less elongated vertically, and the test is probably thinner.

Occurrence.—Rare at Locs. 2, 6 and 7.

Superfamily Veneracea RAFINESQUE, 1815

Family Veneridae RAFINESQUE, 1815

Subfamily Pitarinae STEWART, 1930

Genus *Rasatrix* CASEY, 1952

Rasatrix suzukii HAYAMI, sp. nov.

Plate 51, Figures 19-22

v. 1972. *Eriphyla* sp. cf. *E.* (*Eriphyla*) *pulchella* HAYAMI : SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 6, fig. 7.

Type.—The holotype is a left valve (UMUT MM9771) from Loc. 2.

Material.—In addition to the holotype the following description is based on seven paratypes (UMUT MM9772-9778) from the type locality.

Diagnosis.—Small-sized species of *Rasatrix*, characterized by relatively tall outline, thin test, small apical angle, large and faintly impressed lunule and densely spaced concentric striae which become stronger toward ventral margin.

Description.—Shell small for the genus, rarely exceeding 17 mm in maximum length, trigonally suborbicular, strongly inflated ; length a little larger than height ; test thin ; antero-dorsal margin relatively

long, weakly concave, meeting anterior margin with a very obtuse angle; posterodorsal margin moderate in length, broadly convex, passing into posterior margin with an obtuse angle; ventral margin almost symmetrically arcuate, not clearly separated from anterior and posterior margins; apical angle about 110 degrees; umbo placed submesially or a little anteriorly from mid-length, slightly recurved, prosogyrous; lunule wide, weakly separated from main part by a shallow groove, but not much depressed; escutcheon narrow but distinct, delimitted by a ridge; surface marked with numerous densely spaced concentric striae which become stronger toward ventral margin; growth rings appearing irregularly in adult stage; ventral margin not crenulated internally, and no radial element perceptible; hinge structure unknown.

Table 6. Measurements in mm [*Rasatrix suzukii* HAYAMI, sp. nov.]

Specimen	Length	Height	Thickness
Holotype left valve (MM 9771)	15.4	13.7	3.8
Paratype right valve (MM 9772)	11.4	10.1	ca. 3.0
Paratype left valve (MM 9773)	12.2	10.8	ca. 3.0
Paratype right valve (MM 9774)	13.8	12.4	3.6
Paratype right valve (MM 9775)	10.5	9.9	ca. 2.7
Paratype right valve (MM 9776)	13.5	10.8+	ca. 3.5
Paratype left valve (MM 9777)	16.1+	15.0+	ca. 4.0
Paratype right valve (MM 9778)	14.4+	12.8+	ca. 3.8

Form ratio (Length/Height) N=5, $\bar{x}$=1.111, s=0.029, V=2.608, O.R.=1.061−1.130

Remarks.—The holotype is a nearly complete left valve, though its dorsal margin is still buried in the matrix. Most of the paratypes are incomplete. Because the test is thin and fragile, many specimens were damaged during the mechanical preparation. I have tried in vain to observe the hinge structure by dissolving the test, because the matrix is also calcareous and too coarse-grained.

Notwithstanding these difficulties, the external characters, especially the shell form and weakly impressed lunule, indicate that the present species belongs to the genus *Rasatrix* CASEY, 1952. In comparison with its type-species, *Rasatrix* (s. s.) *dolabra* CASEY, 1952, from the Lower Greensand of England, the shell is smaller and somewhat taller, and the posterodorsal corner is not so clearly angulated. In these respects the present species may be more closely allied to *Cyprimeria* (*Cyclorisma*) *parva* (SOWERBY) from the Lower Greensand of England (WOODS, 1908), which was referred to *Rasatrix* by CASEY (1961) and partly renamed *Rasatrix woodsi* by CASEY (1952). However, the shell is slightly shorter and the apical angle is decidedly smaller in the present species. *Rasatrix* was classified into three subgenera by CASEY (1952, 1961), but the subgeneric reference of the present species cannot be determined here, since the hinge structure is unknown.

SHIKAMA and SUZUKI (1972) collected many specimens of this species from several other localities of the Choshi Group, comparing them with *Eriphyla pulchella* HAYAMI, 1965b, from the lower Albian part of the Miyako Group in north Honshu. Although the suborbicular outline may remind one of that of the Eriphylinae, the present species is certainly unrelated to the Miyako species in view of the much thinner test, stronger shell convexity, denser concentric striae and

different mode of lunule.

Occurrence.—Common at Loc. 2 and Loc. 5.

Suberfamily Myacea LAMARCK, 1809

Family Corbulidae LAMARCK, 1818

Subfamily Caestocorbulinae VOKES, 1945

Genus *Caestocorbula* VINCENT, 1910

Caestocorbula shikamai HAYAMI, sp. nov.

Plate 53, Figures 8-12

v. 1972. *Pulsides* [sic] *higoensis* (MATSUMOTO) : SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 6, figs. 13, 14.

Type.—The holotype is a nearly complete right valve (UMUT MM9753) from Loc. 7.

Material.—In addition to the holotype the following description is based on 15 specimens (MM9754-9763) from the type locality and Loc. 4.

Diagnosis.—Medium-sized and solid species of *Caestocorbula* characterized by the strongly inflated and slightly rostrated right valve, the smaller, not rostrated and weakly constricted left valve and undeveloped concentric ribs.

Description.—Shell medium in size for corbulids, highly inequivalve and inequilateral; test heavy and solid; right valve strongly inflated, shortly but distinctly rostrated with obliquely truncated posterior margin, provided with broad and incurved umbo and broadly concave postero-dorsal margin; left valve much smaller than right, moderately inflated, pyriform, not rostrated but slightly constricted in middle, having nearly straight or a little convex postero-dorsal margin and slightly sinuated ventral margin; siphonal plate of left valve possibly present but not observed; posterior carina rounded in two valves, obscurely defining posterior area; umbo prosogyrous, broad, placed submesially; surface smooth except for densely spaced concentric striae of regular interval. Internally, antero-dorsal, postero-dorsal and ventral margins of right valve distinctly grooved for reception of margins of left valve, indicating the left valve is much smaller and overlapped by right

Table 7. Measurements in mm [*Caestocorbula shikamai* HAYAMI, sp. nov.]

Specimen	Length	Height	Thickness
Holotype right valve (MM 9753)	22.3	16.1	9.4
Paratype right valve (MM 9754)	18.6	13.8	9.0
Paratype right valve (MM 9755)	19.4	14.8	8.2
Paratype right valve (MM 9756)	18.9	14.8	7.6
Paratype right valve (MM 9757)	21.0	15.8	10.1
Paratype left valve (MM 9758)	17.9	13.6	6.6
Paratype left valve (MM 9579)	16.7	12.1	6.3
Paratype left valve (MM 9760)	14.8	11.8	6.5
Paratype right in. mould (MM 9761)	21.3	14.5+	7.5+
Paratype right in. mould (MM 9762)	19.6	13.9	8.5+
Paratype left in. mould (MM 9763)	15.5	12.2	4.5+

Form ratio (Length/Height) Right valves: N $=6$, $\bar{x}=1.343$, $s=0.049$, $V=3.625$, O. R. $=1.277-1.410$; Left valves: $N=4$, $\bar{x}=1.305$, $s=0.056$, $V=4.328$, O. R. $=1.254-1.380$

valve; interior of posterior part of right valve remarkably flattened; right valve provided with a strong tusk-like cardinal tooth and a large resilifer pit behind it, while left valve has a corresponding socket and a subtrigonal chondrophore; adductor muscle scars suboval, clearly impressed, pallial line shallowly sinuated below posterior adductor scar.

Remarks.—The holotype and paratype (MM9754) from Loc. 7 are well preserved and show concentrically ornamented surface. Other paratypes (MM9755-9760) from Loc. 7 show apparently smooth surface, but it is certainly due to pre-depositional abrasion. Three artificial internal moulds (MM9761-9763) were prepared by using HCl and cementing agent, and hinge and other internal structures of two valves were successfully observed.

Although the development of siphonal plate is not actually ascertained, the present species shows similar hinge and other essential characters to the known species of *Caestocorbula*. According to VOKES (1944, 1945, 1946), *Parmicorbula* VOKES, 1944, also has similar discrepant valves and developed pallial sinus, but, as treated by KEEN *in* COX et al. (1969), it is regarded as a subgenus of *Caestocorbula*. Because the siphonal plate is not preserved in the present material, it is difficult to determine whether the present species belongs to *Caestocorbula* (s. s.) or *Parmicorbula*.

The present species is possibly related to *Caestocorbula* (*Parmicorbula*) *neaeroidea* (BLANCKENHORN, 1890) from the Aptian of Lebanon (VOKES, 1944, 1945, 1946), but the posterior rostrum of right valve is much shorter. In this respect it is more similar to *Caestocorbula* (*Caestocorbula*) *olivae* (WHITFIELD) also from the Aptian of Lebanon (VOKES, 1946), but the shell is somewhat larger and the concentric ribs on the surface are much weaker and more densely spaced. SHIKAMA and SUZUKI (1972) referred some specimens of the present species to *Pulsidis higoensis* (MATUMOTO, 1938) from the Upper Albian-Cenomanian Gosyonoura Group and the Albian Yatsushiro Formation of Kyushu. The specific characters of *P. higoensis* became clearer through TAMURA's (1977) study on the material from the Cenomanian Mifune Group of Kyushu. Actually, the outline of right valve and the shape of pallial sinus may be somewhat similar, but the present species differs from that species in the larger shell size, sinuated ventral margin of left valve, more rounded and larger resilifer pit, stronger tusk-like tooth and more remarkably discrepant valves. In the external characters the present species may be most closely akin to *Corbula striatula* J. de C. SOWERBY, 1827, from the Lower Greensand of England (WOODS, 1908), which was regarded by CASEY (1961) as belonging to *Parmicorbula*. However, it differs from the British species in the less sharply carinated outline of right valve, more elongated and weakly constricted left valve and much larger shell size.

Occurrence.—Rare at Locs. 2 and 7 and common at Loc. 4.

Caestocorbula minima HAYAMI, sp. nov.

Plate 53, Figures 15, 16

Type.—The holotype is a nearly complete articulated specimen (UMUT MM 9764) from Loc. 2.

Material.—In addition to the holotype, the following description is supplemented by two paratypes (MM9765, 9766) from the type locality.

Diagnosis.—Small-sized species of *Caestocorbula* characterized by the *Nuculana*-like outline of right valve with a narrow and pointed posterior rostrum, smaller and

triangular left valve with discrepant ventral margin and small flattened siphonal plate, and densely spaced concentric striae on surface.

Description.—Shell very small, scarcely exceeding 10 mm in maximum length, highly inequivalve and inequilateral; test moderate in thickness; right valve much larger than left, *Nuculana*-like in outline, strongly inflated, having a narrowly elongated rostrum which is tapered posteriorly and pointed at end; left valve subtriangular, tightly embraced by valve margin of right valve, having a small, rectangular and flattened siphonal plate corresponding to posterior rostrum of right valve; umbo orthogyrous, placed a little anteriorly from mid-length of shell; surface of two valves marked with densely spaced concentric striae; hinge and other internal characters unknown.

Remarks.—The holotype shows nearly complete outline of two valves and siphonal plate. The posterior rostrum and siphonal plate are broken in another articulated specimen (MM9765). The small rectangular siphonal plate, which appears nearly flat, seems to indicate that the present species belongs to the subgenus *Parmicorbula* VOKES, 1944, instead of *Caestocorbula* (s. str.). However, its subgeneric reference is still uncertain, because of the ignorance of hinge structure.

The present species evidently differs from *Caestocorbula shikamai*, sp. nov. from the Choshi Group in the much smaller size, more densely spaced concentric striae and narrowly elongated posterior rostrum of right valve. *Caestocorbula* (*Parmicorbula*) *striatula* (J. de C. SOWERBY, 1827) may be the closest species so far known. It has comparable size with the present species, but the posterior carina is distinctly sharper in the Lower Greensand species.

Occurrence.—Rare at Loc. 2.

Table 8. Measurements in mm [*Caestocorbula minima* HAYAMI, sp. nov.]

Specimen	Length	Height	Thickness
Holotype conjoined valves (MM 9764)	7.1	4.6	3.8
Paratype, conjoined valves (MM 9765)	7.0+	5.4	4.6
Paratype, left valve (MM 9766)	6.9	5.3	2.1

Subfamily Corbulinae GRAY, 1823

Genus *Corbulomima* VOKES, 1945

Corbulomima sp. cf. *C. nuciformis* VOKES

Plate 53, Figures 13, 14

v. 1972. *Corbulomina* [sic] sp. aff. *C. nuciformis* VOKES: SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Natn. Univ.*, sec. 2, no. 19, pl. 4, figs. 5, 6.

Material.—The following description is based on two articulated specimens (UMUT MM9767, 9768) from Loc. 2.

Description.—Shell very small for corbulids, subtrapezoidal, not rostrated, very inequivalve, inequilateral, strongly inflated; test relatively thin; right valve larger than left with more prominent umbo, overlapping tightly the marginal area of left valve; umbo prosogyrous, placed a little anteriorly from mid-length of valve; anterior margin slightly concave, while posterior margin is broadly convex; a sharp carina running from umbo to postero-ventral angle in each valve, defining clearly posterior area; surface of middle ventral portion ornamented with densely spaced concentric striae, whereas umbonal and posterior areas are nearly smooth; hinge structure unknown; a

Table. 9. Measurements in mm [*Corbulomima* sp. cf. *C. nuciformis* VOKES]

Specimen	Length	Height	Thickness
Conjoined valves (MM 9767)	10.2	8.8	7.1
Conjoined in. mould (MM 9768)	8.5	7.1	6.7

tooth-like buttress developed on the interior of posterior area in each valve.

Remarks.—The test is well preserved in one specimen (MM9767) but nearly completely exfoliated in the other (MM9768). The unequal size and discrepant margins between two valves are clearly observed in these specimens.

As treated adequately by SHIKAMA and SUZUKI (1972), the present species undoubtedly belongs to the genus *Corbulomima* VOKES, 1945, resembling its type-species, *C. nuciformis* VOKES, 1945, from the Aptian of Lebanon. The inequivalve shell with discrepant valve margin, small size and posterior internal buttress are so similar that specific distinction may be difficult. The concentric striae on the ventral surface, however, seem to be finer in the present specimens, if compared with the figured specimen (VOKES, 1946, pl. 10, fig. 16) of the Lebanon species.

The present species may also be related to *Corbula gaultina* PICTET and CAMPICHE, 1864, from the Lower Gault of England (WOODS, 1908), which seems to belong to the same genus, but the shell is somewhat larger and more sharply carinated.

Occurrence.—Rare at Loc. 2 and Loc. 3.

Superfamily Pandoracea RAFINESQUE, 1815

Family Laternulidae HEDLEY, 1918

Genus *Plectomya* DE LORIOL, 1868

Plectomya aritagawana HAYAMI

Plate 53, Figure 17

v. 1966. *Plectomya aritagawana* HAYAMI, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 17, no. 3, p. 168, pl. 25, figs. 14, 15, pl. 26, fig. 2.

1975. *Plectomya aritagawana* HAYAMI : HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 152.

Only an internal mould (UMUT MM9783, 37.1+mm long, 16.8+mm high) is available for this study. It is articulated, but strongly deformed and incomplete. From the general outline and concentric plications restricted to the anterior part, it is referable to *Plectomya aritagawana* HAYAMI, 1966, which has been known from the upper Neocomian Arida Formation in the Kii Peninsula and from the Albian Yatsushiro Formation of middle Kyushu.

Occurrence.—Rare at Loc. 2.

Taxonomic notes on some other bivalve species from the Choshi Group

[by Itaru HAYAMI]

More than 30 species of Bivalvia from the Choshi Group were described or illustrated in previous works (ISHIWATARI, 1906; YEHARA, 1923; MAEDA, 1962; HAYAMI, 1965a, b; SHIKAMA and SUZUKI, 1972; TAMURA, 1978a). About ten of them were already treated in the present description as shown in the synonym lists, but many of them are not represented in our collection. In connection with the present faunal study, these illustrations and, as possible, their original specimens were critically examined. As the result the occurrence of the following species was confirmed [specific name in each previous work, if revised, is shown in brackets].

Portlandia (*?*) sp. [=*Nucnlana* (s.l.) sp. cf. *N. sanchuensis* YABE and NAGAO *sensu* SHIKAMA and SUZUKI, 1972, pl. 4, fig. 3] (Loc. 5). This has a much shorter shell than the type specimen of *Portlandia sanchuensis* and evidently belongs to a different species from the specimens of that species described in this article.

Cucullaea transversa NAGAO [SHIKAMA and SUZUKI, 1972, pl. 4, fig. 8] (Loc. 3).

Eonavicula (*?*) sp. [=*Parallelodon* sp. *sensu* SHIKAMA and SUZUKI, 1972, pl. 4, fig. 4] (Loc. 3).

Gervillia (*Gervillia*) *forbesiana* D'ORBIGNY [SHIKAMA and SUZUKI, 1972, pl. 4, fig. 13] (Loc. 7). Because the specimen is poorly preserved, the specific reference should be ascertained by more amplified material.

Isognomon (*Isognomon*) *choshienis* HAYAMI [HAYAMI, 1965a, p. 279, pl. 39, fig. 1] (Loc. 7). No additional specimens have been collected.

Neithea (*Neithea*) sp. [=*Neithea* (*Neithea*) *amanoi* HAYAMI *sensu* SHIKAMA and SUZUKI, 1972, pl. 4, fig. 15] (Loc. 3). The strong convexity of shell and stout radial ribs seems to differ from those of *Neithea* (*Neithea*) *syriaca amanoi* HAYAMI, 1965a, from the Hagino Formation of central Shikoku. It may belong to *Neithea* (*Neithea*) *ficalhoi* (CHOFFAT, 1888), but the specific determination is difficult at present.

Neithea (*Neithella*) *notabilis* (MÜNSTER) [=*Neithea* (*Neithella*) sp. cf. *N.* (*N.*) *atava* RÖMER *sensu* SHIKAMA and SUZUKI, 1972, pl. 4, fig. 14] (Loc. 3). See HAYAMI and NODA (1977) for the nomenclatorial revision.

Parvamussium sp. [=*Pseudocardia* sp. cf. *P. tenuicosta* (Sowerby) *sensu* SHIKAMA and SUZUKI, 1972, pl. 6, fig. 2] (Loc. 9). This is actually not a carditid, but can be assigend to a deformed left valve of a propeamussiid. It resembles *Parvamussium kimurai* HAYAMI, 1965, from the Upper Neocomian and Aptian of Shikoku and Kyushu, but the radial riblets seem more numerous.

Plicatula sp. [SHIKAMA and SUZUKI, 1972, pl. 4, fig. 16] (Loc. 3).

Spondylus sp. [=*Spondylus* sp. aff. *S. decoratus* NAGAO *sensu* SHIKAMA and SUZUKI, 1972, pl. 5, fig. 1] (Loc. 3).

Acesta (*?*) sp. [=*Plagiostoma* sp. *sensu* SHIKAMA and SUZUKI, 1972, pl. 5, fig. 2] (Loc. 3).

Limidae gen. and sp. indet. [=*Lima* sp. *sensu* SHIKAMA and SUZUKI, 1972, pl. 5, fig. 3] (Loc. 3).

Limatula nagaoi HAYAMI [SHIKAMA and SUZUKI, 1972, pl. 5, fig. 4] (Loc. 3).

Rastellum (*Arctostrea*) *carinatum* (LAMARCK) [=*Lopha* (*Arctostrea*) *carinata* (LAMARCK) *sensu* SHIKAMA and SUZUKI, 1972, pl. 5, fig. 5] (Loc. 3).

Gryphaea (*Bilobissa* ?) sp. [=*Gryphaea* sp. *sensu* SHIKAMA and SUZUKI, 1972, pl. 5, figs. 6, 7] (Loc. 3).

Lopha (*Actinostreon*) *nagaoi* HAYAMI [=*Lopha* (*Lopha*) *nagaoi* HAYAMI *sensu* SHIKAMA and SUZUKI, 1972, pl. 5, fig. 8] (Loc. 3).

Amphidonte (*Amphidonte*) *subhaliotoidea* (NAGAO) [SHIKAMA and SUZUKI, 1972, pl. 5, figs. 10-14] (Loc. 3)

Amphidonte (*Ceratostreon*) *yabei* (NAGAO) [SHIKAMA and SUZUKI, 1972, pl. 5, fig. 9] (Loc. 3).

Nipponitrigonia choshiensis MAEDA [MAEDA, 1962, p. 507, pl. 4, figs. 1-13; SHIKAMA and SUZUKI, 1972, pl. 6, fig. 1] (Ashikajima and Inubo-zaki; Loc. 7).

Pachythaerus sp. [=*Astarte subsenecta* YABE and NAGAO *sensu* SHIKAMA and SUZUKI, 1972, pl. 6, fig. 4] (Loc. 3). Although *Astarte subsenecta* is actually represented by many specimens in SHIKAMA and SUZUKI's collection, this illustrated specimen seems to belong to an unnamed species of *Pachythaerus*.

Astarte (*Yabea*) *shinanoensis* YABE and NAGAO [=*Astarte* sp. cf. *A.* (*Yabea*) *akatsui* HAYAMI *sensu* SHIKAMA and SUZUKI, 1972, pl. 6, fig. 6] (Loc. 3).

Opis (*?*) sp. [=*Opis* sp. *sensu* SHIKAMA and SUZUKI, 1972, pl. 6, fig. 8] (Loc. 3).

There are some other bivalves which were illustrated by SHIKAMA and SUZUKI (1972) under the following specific names, but their generic and specific identifications are hardly confirmable owing to the unfavorable state of preservation:

Inoceramus sp. cf. *I. yabei* NAGAO and

MATSUMOTO [pl. 4, fig. 9] (Loc. 3).

Inoceramus sp. cf. *I. concentricus nipponicus* NAGAO and MATSUMOTO [pl. 4, fig. 10] (Loc. 3).

Pseudocardia amanoi HAYAMI [pl. 6, fig. 3] (Loc. 3)

Costocyrena matsumotoi HAYAMI [pl. 6, fig. 11] (Loc. 3).

The specimen, which was illustrated by SHIKAMA and SUZUKI (1972, pl. 4, fig. 12) under the name of *Pterinella*(?) sp., is probably not a bivalve but seems to belong to a certain crustacean species.

Concluding remarks on the bivalve fauna of the Choshi Group

When one of us (HAYAMI, 1966) summarized the stratigraphic and geographic distributions of Early Cretaceous marine bivalves in Japan, the characters of Choshi fauna could hardly be made clear, because only a few species had been described. As treated in the present study, however, the occurences of 36 bivalve species are confirmed in this group, and it becomes possible for us to compare the specific assemblage with nearly contemporaneous (Barremian—Lower Albian) faunas of other regions.

The specific assemblage is, however, considerably different among localities and horizons. Three types of faunules are distinguishable in the Choshi Group.

The first type (Kimigahama-type faunule) is characterized by the abundant occurrence of *Nuculopsis* (*Palaeonucula*) *ishidoensis*, *Grammatodon* (*Nanonavis*) *yokoyamai*, *Rasatrix suzukii* and many gastropods in fine-grained sediments, as exemplified by the fossils at Loc. 2 of Kimigahama. Rocky bottom inhabitants are scarcely found, and these infaunal species seem to indicate a level bottom condition of relatively low energy, as inferred from the lithology and state of fossil preservation.

The second type (Ashikajima-type faunule) is characterized by the predominance of *Astarte* (*Astarte*) *subsenecta* and *Caestocorbula shikamai* in medium-grained sandstones as exemplified by the fossils at Loc. 4 of Nagasaki and Locs. 7 and 8 of Ashikajima. This may also be a level bottom faunule but the lithology and mode of fossil occurrence indicate a sedimentary environment of relatively high energy.

The third type (Nagasaki-type faunule) is characterized by the common occurrence of *Amphidonte* (*Amphidonte*) *subhaliotoidea* and many other epifaunal species of Pteriomorphia in some calcareous siltstone. The faunule of this type occurred at Loc. 3 of Nagasaki and is recognized only through a collection of Yokohama National University which was partly illustrated by SHIKAMA and SUZUKI (1972). Unfortunately, this locality seems to have been concealed by the construction of a harbor. This faunule is probably a post-mortem mixture of level bottom and rocky bottom dwellers.

In the next place, we intend to compare quantitatively the constituent species of these faunules (and their integration) with hitherto known faunas of other regions in Japan. Various kinds of binary similarity indices have been applied for the comparison of local faunas, and their properties were discussed in detail (SIMPSON, 1960; SOKAL and SNEATH, 1963; CHEETHAM and HAZEL, 1969; etc.). The following three indices are used in the present study:

SIMPSON Coefficient (S_S): C/N_1

JACCARD Coefficient (S_J): $C/(N_1+N_2-C)$

DICE Coefficient (S): $2C/(N_1+N_2)$

where N_1 and N_2 are the numbers of constituent species in two faunas under comparison ($N_1 \leqq N_2$) and C is the number of common species between the two faunas. Occurrence of a comparable species is conventionally counted as a half common

element. Because all the fossil bivalves so far known from the Choshi Group are decidedly purely marine species, brackish- and fresh-water species (e. g. neomiodontids, corbiculids, some bakevelliids and some corbulids) in other regions are excluded from this comparative study.

The Kimigahama-type faunule contains several common elements with the fauna of the Ishido Formation in the Sanchu area of Kwanto mountains [N_1=15, N_2=30, C=5.5, S_S=0.367, S_J=0.186, S_D=0.244], and with that of the Lower Monobegawa Group (Hachiryuzan, Hinagu and Yatsushiro Formations) in Kuma mountains of middle Kyushu [N_1=15, N_2=40, C=4.5, S_S=0.300, S_J=0.089, S_D=0.164]. On the other hand, there is only one common species with the fauna of the Miyako Group in the Kitakami mountains of north Honshu [N_1=15, N_2=76, C=1, S_S=0.067, S_J=0.011, S_D=0.022]. Marked difference of specific composition between the present faunule and the Miyako fauna was also demonstrated by KASE and MAEDA (1980) on gastropods.

The Ashikajima-type faunule, though the number of species is too small to calculate similarity indices, also appears to show more intimate relation to the Sanchu and Kuma faunas than the Miyako fauna.

The Nagasaki-type faunule is, on the contrary, characterized by a number of common species not only with the Sanchu fauna [N_1=20, N_2=30, C=4.5, S_S=0.225, S_J=0.099, S_D=0.180] and the Kuma fauna [N_1=20, N_2=40, C=2.5, S_S=0.125, S_J=0.043, S_D=0.083] but also with the Miyako fauna [N_1=20, N_2=76, C=7, S_S=0.350, S_J=0.079, S_D=0.146].

The Choshi Group ranges from the Barremian to the lower Upper Aptian (OBATA et al., 1975), and is evidently older than the Miyako Group which ranges from the middle Upper Aptian to the upper Lower Albian. The result of above mentioned comparative study seems to indicate that the discrepancy of bivalves between Choshi and Miyako is considerably due to the difference of sedimentary facies. Incidentally, calcareous reef deposits are predominant in the Miyako Group, but scarcely known in the Choshi Group and other Early Cretaceous marine formations in central and west Japan.

Binary similarity indices (S_S, S_J and S_D) were also calculated between a pair of local marine bivalve faunas in the Lower Cretaceous of Japan (Table 10 and Table 11). The bivalve fauna of the Choshi Group, which is the integration of these three and a few other smaller faunules, shows the most intimate relation to the Sanchu fauna, but also bears several common elements with the Miyako, Susaki and Kuma faunas. The similarity indices between the Sanchu and Kuma faunas are notably high. The bivalve fauna of the Lower Monobegawa Group in Shikoku (Katsuuragawa and Monobegawa areas), which was partly described by HAYAMI (1965a, b, 1966) and others and is now more intensively studied by TASHIRO (oral communication), also contains many common elements with the Sanchu and Kuma faunas. Furthermore, Upper Neocomian faunas of the Oshima Formation and the Ofunato Group in Kitakami mountains also bears some common bivalves with the Choshi, Sanchu and Kuma faunas.

As theoretically discussed by SIMPSON (1960) and some others, discrepancies in sample size (number of species) between two faunas may have strong influence on JACCARD and DICE Coefficients, but not so significantly on SIMPSON Coefficient. Actually, the calculated values of S_J and S_D related to the Susaki fauna, which is relatively small in number of constituent species, are much lower than those of other cases, but such a tendency is not

Table 10. Number of common species (right upper) and SIMPSON Coefficient (S_S; left lower) between each pair of local marine bivalve faunas in Japan.

Fauna	Strata	References	Number of species	Miyako	Choshi	Sanchu	Susaki	Kuma
Miyako	Miyako Group	NAGAO, 1934 HAYAMI, 1965-66	76	*	9	11	2.5	9
Choshi	Choshi Group	HAYAMI and OJI, 1980	36	.250	*	9.5	3	8.5
Sanchu	Ishido Formation	YABE, NAGAO and SHIMIZU, 1926 HAYAMI, 1965-66	30	.367	.317	*	2	15
Susaki	Doganaro Formation	HAYAMI and KAWASAWA, 1967 KATTO and TASHIRO, 1978	12	.208	.250	.167	*	3
Kuma	Lower Monobegawa Group	HAYAMI, 1965-66	40	.225	.236	.500	.250	*

Table 11. Binary similarity indices, JACCARD Coefficient (S_J; right upper) and DICE Coefficient (S_D; left lower) between each pair of local marine bivalve faunas in Japan.

Fauna	Strata	References	Number of species	Miyako	Choshi	Sanchu	Susaki	Kuma
Miyako	Miyako Group	NAGAO, 1934 HAYAMI, 1965-66	76	*	.087	.116	.029	.084
Choshi	Choshi Group	HAYAMI and OJI, 1980	36	.161	*	.168	.067	.126
Sanchu	Ishido Formation	YABE, NAGAO and SHIMIZU, 1926 HAYAMI, 1965-66	30	.208	.288	*	.050	.273
Susaki	Doganaro Formation	HAYAMI and KAWASAWA, 1967 KATTO and TASHIRO, 1978	12	.057	.125	.095	*	.061
Kuma	Lower Monobegawa Group	HAYAMI, 1965-66	40	.155	.224	.429	.115	*

apparent in the values of S_S. Although these similarity indices are changeable by future taxonomic and stratigraphic studies, it may be conclusive that none of these local faunas was strictly isolated from those of other regions. Many of these bivalves are, as empirically recognized, long-ranging species, and the faunal similarity and difference are regarded as primarily due to paleoenvironmental factors rather than chronological.

Cosmopolitan and foreign elements appear to be rare in the bivalve fauna of the Choshi Group. Only the occurrence of *Gervillia* (*Gervillia*) *forbesiana* and *Neithea* (*Neithella*) *notabilis*, which were originally known in western Europe, is confirmed in SHIKAMA and SUZUKI's collection. In the Early Cretaceous bivalve faunas of Japan, however, there are a large number of common or closely related bivalves with Tethyan and European faunas, especially Aptian ones of Lebanon, Caucasus, Crimea and western Europe (HAYAMI, 1966, p. 192). The three species of the Corbulidae described in the present paper are also good examples of such a faunal connection. Provinciality is not

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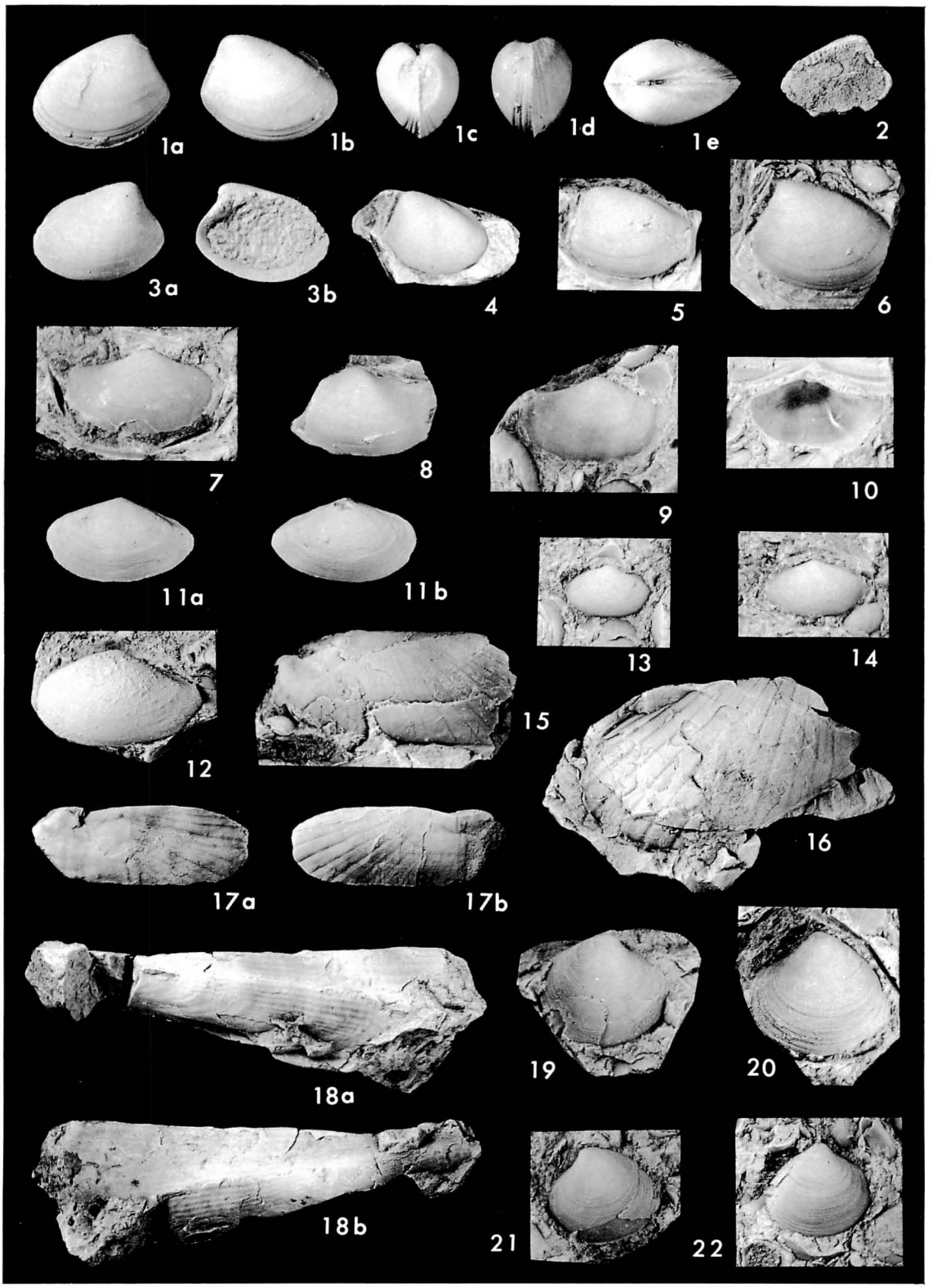
Explanation of Plate 51

Nuculopsis (*Palaeonucula*) *ishidoensis* (YABE and NAGAO) ..... p. 423
Fig. 1. Conjoined valves (MM 9701) ×1.5. 1a: left view, 1b: right view, 1c: anterior view, 1d: posterior view, 1e: dorsal view. Loc. 2.
Fig. 2. Right valve showing hinge teeth (MM 9716) ×1.5. Loc. 4.
Fig. 3. Left valve (MM 9713) ×1.5. 3a: external view, 3b: internal view. Loc. 2.
Fig. 4. Right valve (MM 9704) ×1.5. Loc. 2.
Fig. 5. Right valve (MM 9703) ×1.5. Loc. 2.
Fig. 6. Right valve (MM 9702) ×1.5. Loc. 2.
Portlandia sanchuensis (YABE and NAGAO) ..... p. 425
Fig. 7. Right valve (MM 9718) ×1.5. Loc. 2.
Fig. 8. Left valve (MM 9720) ×1.5. Loc. 2.
Fig. 9. Right internal mould (MM 9719) ×1.5. Loc. 2.
Fig. 10. Right valve (internal view) (MM 9721) ×1.5. Loc. 2.
Mesosaccella(*?*) *choshiensis* HAYAMI, sp. nov. ..... p. 426
Fig. 11. Conjoined valves (MM 9722), holotype, ×2. 11a: left view, 11b: right view. Loc. 2.
Fig. 12. Left valve (MM 9723), paratype, ×2. Loc. 2.
Mesosaccella(*?*) sp. ..... p. 427
Fig. 13. Left valve (MM 9784) ×2. Loc. 2.
Fig. 14. Right valve (MM 9785) ×2. Loc. 2.
Solemya sp. ..... p. 427
Fig. 15. Right valve (MM 9725) ×1.5. Loc. 1.
Fig. 16. Left valve (MM 9726) ×1.5. Loc. 1.
Fig. 17. Internal mould of conjoined valves (MM 9727) ×1.5. 17a: right view, 17b: left view. Loc. 2.
Pinna sp. ..... p. 430
Fig. 18. Conjoined valves (MM 9743) ×1.5. 18a: left view, 18b: right view. Loc. 2.
Rasatrix suzukii HAYAMI, sp. nov. ..... p. 434
Fig. 19. Right valve (MM 9774), paratype, ×1.5. Loc. 2.
Fig. 20. Left valve (MM 9771), holotype, ×1.5. Loc. 2.
Fig. 21. Left valve (MM 9773), paratype, ×1.5. Loc. 2.
Fig. 22. Right valve (MM 9772), paratype, ×1.5. Loc. 2.


1a
1b
1c
1d
1e
2
3a
3b
4
5
6
7
8
9
10
11a
11b
13
14
12
15
16
17a
17b
18a
19
20
18b
21
22

clearly exhibited in the bivalve faunas of this period.

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Explanation of Plate 52

Grammatodon (*Nanonavis*) *yokoyamai* YABE and NAGAO ..... p. 428

Fig. 1. Conjoined valves (MM 9732) ×1.5. 1a: left view, 1b: right view. Loc. 2.

Fig. 2. Artificial internal mould of right valve (MM 9739) ×1.5. Loc. 2.

Fig. 3. Conjoined valves (MM 9736) ×1.5. 3a: left view, 3b: right view. Loc. 2.

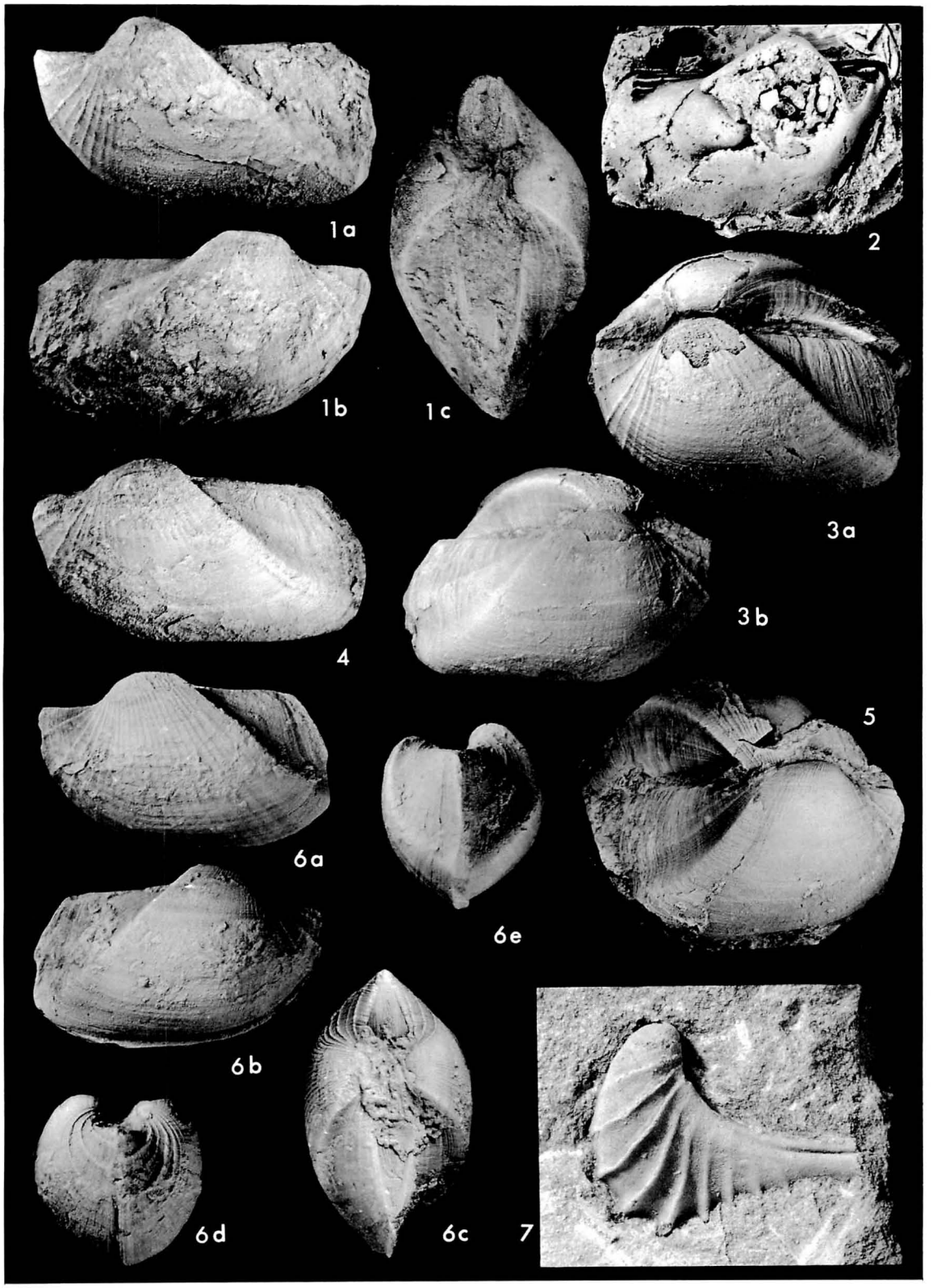
Fig. 4. Left valve (MM 9734) ×1.5. Loc. 2.

Fig. 5. Conjoined valves (right view) (MM 9737) ×1.5. Loc. 2.

Fig. 6. Conjoined valves (MM 9731) ×1.5. 6a: left view, 6b: right view, 6c: dorsal view, 6d: anterior view, 6e: posterior view. Loc. 2.

Pterotrigonia (*Pterotrigonia*) *pocilliformis* (YOKOYAMA) ..... p. 431

Fig. 7. Left internal mould (MM 9779) ×1.5. Loc. 5.


1a
1b
1c
2
3a
3b
4
5
6a
6b
6c
6d
6e
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銚子地方産の前期白亜紀二枚貝類：千葉県銚子半島南東海岸に沿って露出する銚子層群(バレミアン—アプチアン階)には以前から多くの二枚貝化石が産出することが知られていたが，分類学的記載が断片的であったため，その全ぼうは必ずしも明らかではなかった。今回，大吠埼北方の君ヶ浜などの産地でかなり保存良好の軟体動物化石群が発見され，検討した結果，4新種を含む次の13属・15種を識別したので記載する（共産する腹足類化石は加瀬・前田(1980)に記載されている)。*Nuculopsis* (*Palaeonucula*) *ishidoensis*, *Portlandia sanchuensis*, *Mesosaccella*(?) *choshiensis* sp. nov., *Mesosaccella*(?) sp., *Solemya* sp., *Grammatodon* (*Nanonavis*) *yokoyamai*, *Pinna* (*Pinna*) sp., *Pterotrigonia* (*Pterotrigonia*) *pocilliformis*, *Astarte* (*Astarte*) *subsenecta*, *Laevicardium*(?) sp. aff. *L.*(?) *ishidoense*, *Rasatrix suzukii* sp. nov., *Caestocorbula shikamai* sp. nov., *Caestocorbula minima* sp. nov., *Corbulomima* sp. cf. *C. nuciformis*, *Plectomya aritagawana*. これらの種の一部は関東山地の石堂層や西南日本外帯の下部物部川層群に産する既知種であるが，保存良好の標本によって種の特徴がより明確となった。今回採集できなかったが従来銚子層群から産出し図示されている標本をあわせて検討したところ，本層群から産する化石二枚貝は32属36種に達することが判明した。これらを本邦他地域の同時期の化石群と比較すると，関東山地の石堂層の二枚貝群に最も類似度が高いが，鹿間・鈴木 (1972) による長崎港の1産地の採集品は宮古層群に共通する種をかなり多く含んでいる。

速水 格・大路樹生

Ashikajima 海鹿島, Choshi 銚子, Inubo-zaki 犬吠埼, Isejigaura 伊勢路ヶ浦, Kimigahama 君ヶ浜, Nagasaki 長崎, Nagasaki-hana 長崎鼻, Tokawa 外川, Toriakeura 酉明浦

Explanation of Plate 53

Astarte (*Astarte*) *subsenecta* YABE and NAGAO ..... p. 431

Fig. 1. Right valve (MM 9744) ×1.5. Loc. 4.
Fig. 2. Left valve (MM 9786) ×1.5. Loc. 7.
Fig. 3. Right valve (MM 9746) ×1.5. Loc. 4.
Fig. 4. Right valve (internal view) (MM 9747) ×1.5. Loc. 4.
Fig. 5. Left valve (internal view) (MM 9787) ×1.5. Loc. 7.
Fig. 6. Right valve (MM 9748) ×1.5. Loc. 4.

Laevicardium(*?*) sp. aff. *L.*(*?*) *ishidoense* (YABE and NAGAO) ..... p. 434

Fig. 7. Left valve (MM 9769) ×1.5. 7a: internal mould with partly preserved shell, 7b: Rubber cast from the same external mould. Loc. 2.

Caestocorbula shikamai HAYAMI, sp. nov. ..... p. 436

Fig. 8. Rubber cast from a left internal mould (MM 9763), paratype, ×1.5. Loc. 4.
Fig. 9. Rubber cast from a right internal mould (MM 9762), paratype, ×1.5. Loc. 4.
Fig. 10. Right valve (MM 9753), holotype, ×1.5. 10a: right view, 10b: dorsal view, 10c: anterior view. Loc. 7.
Fig. 11. Right valve (MM 9755), paratype, ×1.5. 11a: right view, 11b: internal view. Loc. 4.
Fig. 12. Left valve (MM 9759), paratype, ×1.5. Loc. 4.

Corbulomima sp. cf. *C. nuciformis* VOKES ..... p. 438

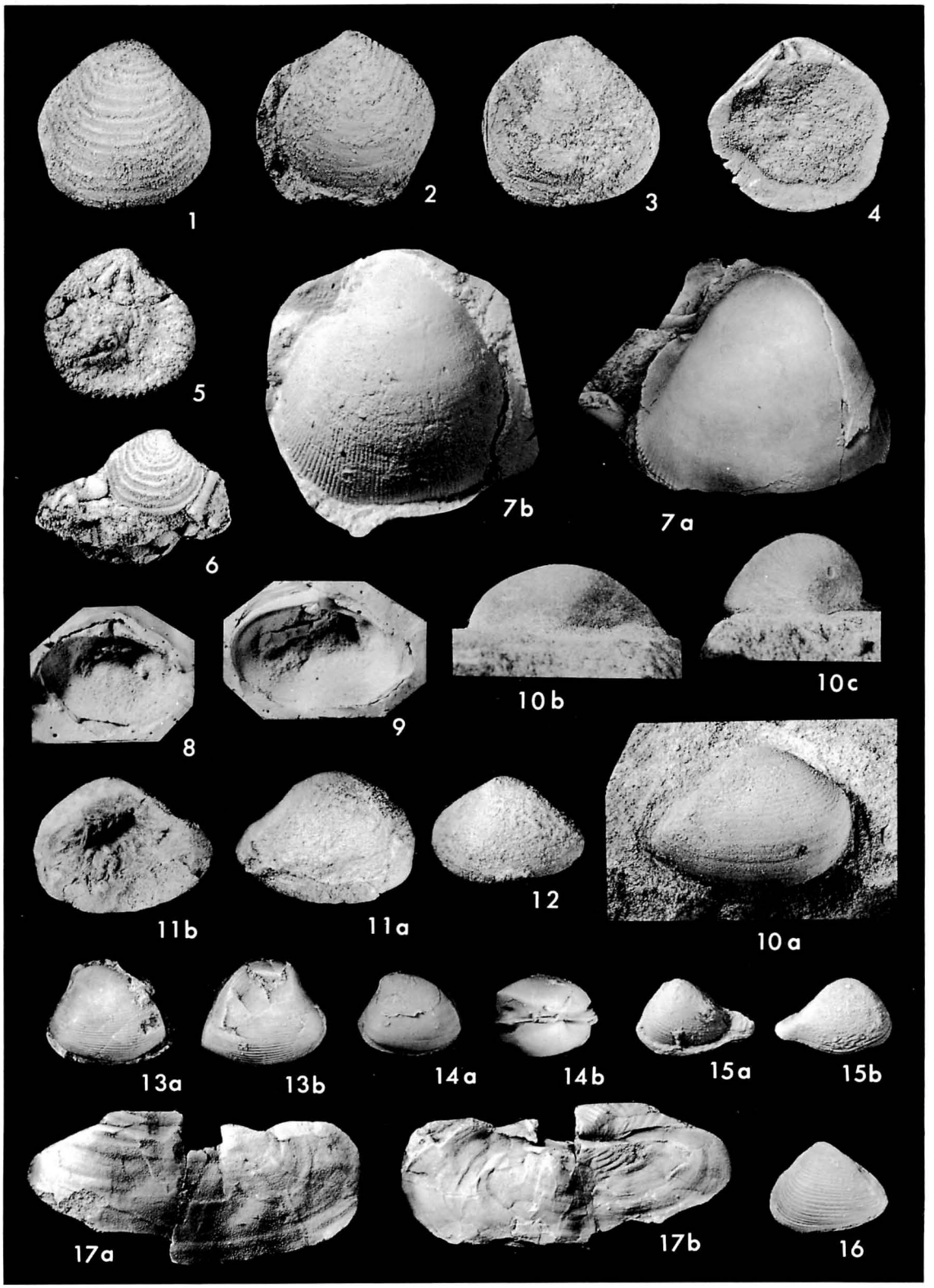
Fig. 13. Conjoined valves (MM 9767) ×2. 13a: left view, 13b: right view. Loc. 2.
Fig. 14. Internal mould of closed valves (MM 9768) ×2. 14a: left view, 14b: dorsal view. Loc. 2.

Caestocorbula minima HAYAMI, sp. nov. ..... p. 437

Fig. 15. Conjoined valves (MM 9764), holotype, ×2.7. 15a: left view, 15b: right view. Loc. 2.
Fig. 16. Left valve (MM 9766), paratype, ×2.7. Loc. 2.

Plectomya aritagwana HAYAMI ..... p. 439

Fig. 17. Internal mould of closed valves (MM 9793) ×1.5. 17a: left view, 17b: right view, Loc. 2.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724. EARLY JURASSIC PLANTS IN JAPAN. PART 2*

TATSUAKI KIMURA and MASANORI TSUJII

Tokyo Gakugei University, Koganei, Tokyo 184

Abstract. This is the second of serial papers on the early Jurassic plants in Japan. In this paper we describe *Marattia asiatica* belonging to the Marattiaceae, and *Todites* cfr. *denticulatus*, *T. fastuosus* (KIMURA) comb. nov., *T. neiridaniensis* sp. nov. and *Osmundopsis nipponica* sp. nov. belonging to the Osmundaceae.

Introduction and acknowledgement

Continued from our previous paper treating Equisetales (KIMURA and TSUJII, 1980), we here describe the fossils belonging to the Marattiaceae and Osmundaceae from the Lower Jurassic Kuruma Group and Iwamuro Formation. The details of stratigraphy of plant-bearing formations and localities were already mentioned in our previous paper.

We express our sincere gratitude to Professor Emeritus Thomas M. HARRIS, F.R.S. of the University of Reading for his helpful suggestions and critical reading over the present manuscript.

Systematic description

Family Marattiaceae

Genus *Marattia* SCHWARTZ, 1788

We followed HARRIS (1961) in using the generic name *Marattia* instead of *Marattiopsis* SCHIMPER.

Marattia asiatica (KAWASAKI) HARRIS

Pl. 54 Fig. 1; Pl. 55, Figs. 1-3; Text-figs. 1a-i

Marattiopsis asiatica KAWASAKI: KAWASAKI, 1939, pp. 50, 56 (nomenclature).

Marattia asiatica (KAWASAKI) HARRIS: HARRIS, 1961, pp. 73, 75 (nomenclature): KILPPER, 1964, p. 24, pl. 3, figs. 1-2 (Liassic of North Iran): HSÜ et al., 1979, p. 20, pl. 5, figs. 4, 5a (Upper Triassic of SW-Sichuan, China).

Marattiopsis muensteri (GOEPPERT) SCHIMPER: KAWASAKI, 1925, p. 26, pl. 36, fig. 101; pl. 37, fig. 102 (Upper Triassic of Daedong Group, Korea): 1926, p. 18, pl. 1, fig. 2 (ditto): OISHI, 1931, p. 242, pl. 16, fig. 10, 10a (Kuruma Group); 1932, p. 272, pl. 20, figs. 4-6 (Upper Triassic Nariwa Group): 1940, p. 192 (general remarks).

Marattiopsis cfr. *muensteri* (GOEPPERT) SCHIMPER: SZE & HSÜ, 1954, p. 44, pl. 39, figs. 1-2 (Lower Jurassic Yipinglang and Xiangxi Formations, Yunnan and Hubei, China).

Taeniopteris (*Marattia*) *münsteri* GOEPPERT: ZEILLER, 1903, p. 63, pl. 9, figs. 6-8 (Upper Triassic of North Viet-Nam).

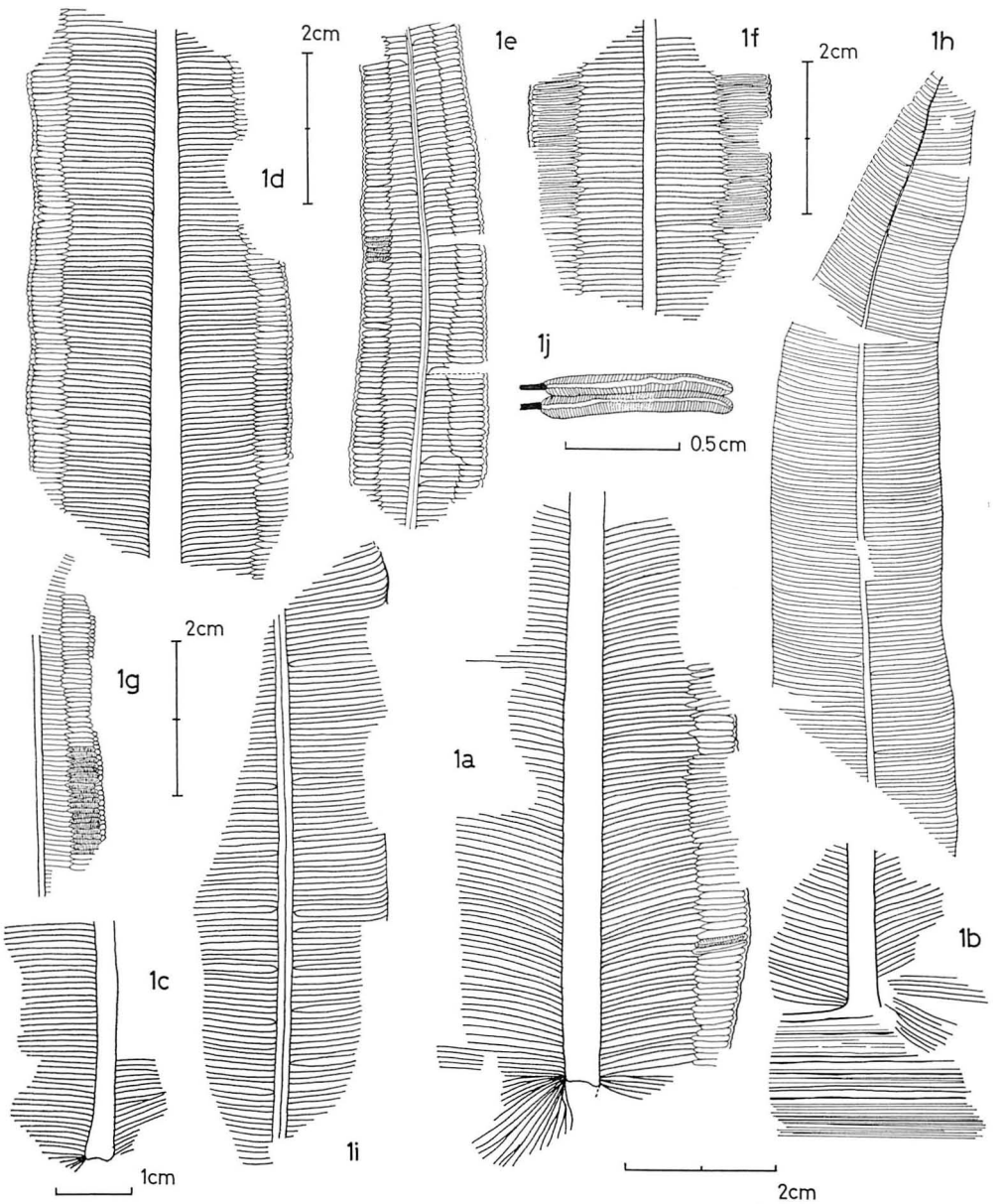
Taeniopteris sp.: KIMURA, 1959b, p. 75, pl. 1, fig. 3 (Kuruma Group).

Material: NNW-216, 321, 415, 439, 483, 495, 499, 573, 644, 690, 816 and other 27 specimens (Nishi-Neiridani); NEE-017, 081, 088, 121, 133, 136, 139, 332, 351 and other 12 specimens (Higashi-Neiridani); NE-078 and other 5 speci-

* Received August 27, 1980; read January 25, 1980 at Tsukuba.

mens (Neiridani); NEG-048 and other 15 specimens (Negoya); DAI-091 (Dairagawa); KA-015 (Kawagurodani); Kr-046 (Tsuchizawa); 4982801-1 (Kotaki Coal-Field); A-0441, 494 and other 5 specimens (Iwamuro).

Description.—92 specimens were obtained from the Kuruma Group and Iwamuro Formation. They are all fragments of detached ribbon-like pinnae excluding one shown in Text-fig. 1c in which a sessile pinna is attached nearly perpendicularly to a thick rachis, more than 1.8 cm wide.



It has longitudinal striations on the surface.

The sterile and fertile pinnae resemble one another in size and shape, the fertile being by far the commoner. The pinnae taper evenly for a considerable distance from the base, but becoming more acute to a somewhat obtusely pointed apex, and are mostly 21-40 mm wide (range noted 14-40.5 mm); among 41 specimens measured excluding ones near the apex and base, the distribution of width and their frequency (in parentheses) are as follows; 14-15 mm (4), 16-20 mm (3), 21-25 mm (6), 26-30 mm (10), 31-35 mm (8), 36-40 mm (8), 40.5 mm (2). The midrib with longitudinal fine striations on its surface, is about 4.5 mm wide near the base of a large pinna. The pinna margins are either entire or sometimes broadly undulated.

The lamina extends backwards beyond the base of midrib as a pair of rounded lobes to make a prominently cordate base. Throughout the greater part of a pinna, the lateral veins arise at a narrow angle but soon bend outwards and meet the margin perpendicularly as shown in Text-fig. 1d, or arise perpendicularly or obliquely to the midrib, then running nearly straight to the margin as shown in Text-figs. 1a and 1h; they sometimes bend forwards at the margin as shown in Text-figs. 1h and 1i. In the basal lobes the veins bend backwards, while they are straight and make an angle of 50-55 degrees near the apex and often of 70 degrees near the base. The veins are simple or forked and sometimes branch close to the midrib, and those on the lobes branch twice or thrice as shown in Text-fig. 1a, but those near the apex and the base just above the lobes do not branch. The concentration of veins reaching the margin is mostly 13-15 per cm (range noted 12-18); among 44 specimens measured, its distribution and their frequency are, 12 per cm (5), 13(10), 14(15), 15(7), 16(4), 17(2), 18(1). There is no interrelation between the size of pinnae and the density of veins. The interstitial ridges (*venuli recurrentes*) are often

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Text-figs. 1a-j. *Marattia asiatica* (KAWASAKI) HARRIS

1a. Basal part of a detached fertile pinna with asymmetrically developed basal lobes; the ratio of synangial length to width of lamina is 1/10 (the lower limit of its variation); back-side view. NNW-720 (Nishi-Neiridani).

1b. A sterile pinna with asymmetrically developed basal lobes; back-side view. NNW-573 (Nishi-Neiridani).

1c. A detached sterile pinna with asymmetrical basal lobes; back-side view. NEE-133 (Higashi-Neiridani).

1d. A middle part of fertile pinna; the ratio of synangial length to width of lamina is 1/8; back-side view. NNW-816 (Nishi-Neiridani).

1e. Ditto; the ratio of synangial length to width of lamina is 1/4.9; surface view. NEE-081 (Higashi-Neiridani).

1f. Ditto; the ratio of synangial length to width of lamina is 1/5.2; back-side view. A-0494 (Iwamuro).

1g. Ditto; the ratio of synangial length to width of lamina is estimated as 1/5; back-side view. NEE-017 (Higashi-Neiridani).

1h. A sterile pinna; apical part is missing; back-side view. NEE-332 (Higashi-Neiridani).

1i. Ditto; surface view. 4982801-1 (Kotaki Coal-Field), reinserted from KIMURA, 1959b (pl. 1, fig. 3; *Taeniopteris* sp.).

1j. Dehisced synangia, enlarged from NNW-690 (Nishi-Neiridani).

recognizable.

The synangia are mostly 3.1-7 mm long (range noted 2-9 mm); among 43 specimens measured, the distribution of length and their frequency are, 2-3 mm (7), 3.1-4 mm (9), 4.1-5 mm (11), 5.1-6 mm (8), 6.1-7 mm (6), 7.1-9 mm (2); the shorter ones are restricted to the area near the apex. The synangia occupy mostly 1/4-1/7 (range noted 1/3.3-1/10) of width of the lamina; among 41 specimens measured, the distribution of ratios and their frequency are, 1/3.3-1/4 (2), 1/4.1-1/5 (10), 1/5.1-1/6 (10), 1/6.1-1/7 (6), 1/7.1-1/8 (3), 1/8.1/1/9 (5), 1/9.1-1/10 (5).

The synangia are 0.83 mm wide and project a considerable distance outwards from the surface. All of them are dehisced. The outer walls are thick and gape and their inner surface is marked with little indication of transverse ridges; the number of ridges is 60-70 in the longest synangia as shown in Text-fig. 1j. Thus spores are not known.

We looked for but could not detect any differences between the specimens from our different localities.

Distribution.—In Japan *Marattia asiatica* is distributed in the Noric Nariwa Group and the Lower Jurassic Kuruma Group and Iwamuro Formation. Outside of Japan, this species is known from the Upper Triassic of Korea, China (SW-Sichuan), North Viet-Nam and North Iran, and the Lower Jurassic of China (Yunnan and Hubei).

Discussion and comparison. — As mentioned above, our specimens show wide range of variation in the width of pinnae, the concentration of veins and the length of synangia. The expanded diagnosis given by KILPPER (1964) agrees with our specimens described above. In addition we first show the basal lobes of this species.

Fossil *Marattia* (or *Marattiopsis*) species have been defined by the combination of the following features of pinnae; the shape of pinna base, the width of pinnae, the pinna margins, the length of synangia, the mode of branching of veins, the concentration of veins, the existence of interstitial ridges and the markings on the surface of midrib.

From HARRIS' description (1931), KAWASAKI received a hint that the specimens described by ZEILLER (1903) from North Viet-Nam differed from *Marattiopsis muensteri* and *M. hoerensis* in having more crowded veins, and probably therefore his specimens represented a distinct species. Consequently KAWASAKI (1939) proposed *Marattiopsis asiatica* based on the Viet-Namese, Japanese and Korean specimens which had been referred to *Marattiopsis muensteri* (GOEPPERT) by ZEILLER (1903), OISHI (1931, 1932) and by himself (1925, 1926).

OISHI's specimens (1931) from the Kuruma Group at Tsuchizawa agree in all features with the present ones. The sterile pinna fragment described by KIMURA (1959b) as *Taeniopteris* sp. from the Kuruma Group at Kotaki Coal-field is now safely referable to *Marattia asiatica*.

OISHI's specimens (1932) from the Nariwa Group agree with the present ones in the width of pinnae and the length of synangia. But their smaller number of veins (12 per cm) probably led HSÜ et al. (1979) to continue to regard these OISHI's specimens as representing *Marattia muensteri*. We believe OISHI's specimens to be referable to *M. asiatica*, because their concentration of veins possibly represent the lower limit of its variation.

KAWASAKI's specimens (1925, 1926) from the Daedong Group of Korea and ZEILLER's ones (1903) agree well with the present ones in all features.

The specimens described by HSÜ et al.

(1979) are indistinguishable from the present ones in all features. *Marattiopsis* cfr. *muensteri* illustrated by SZE & HSÜ (1954) from the Yipinglang Formation in Yunnan and Xiangxi Formation in Hubei of China, may be referable to *M. asiatica*, because, according to SZE & HSÜ, its concentration of veins is said to be 15-18 per cm.

KILPPER's specimens (1964) from the Liassic of North Iran are also indistinguishable from the present ones, because in his specimens, pinnae are 3.5 cm wide, the concentration of veins, 12-18 per cm and the length of synangia, 2.5-7 mm.

The following European species, *Marattia muensteri* (GOEPPERT) SCHIMPER, *M. hoerensis* SCHIMPER and *M. anglica* (THOMAS) HARRIS are similar in the shape of pinnae to *M. asiatica*. But *Marattia asiatica* is distinguishable from them in having more crowed veins, 12-18 per cm instead of about 10 per cm in *M. muensteri* and *M. hoerensis*, and 10-12 per cm in *M. anglica*.

In our collection there are several specimens showing prominent basal lobes. These lobes are similar in shape to those of *Marattia hoerensis*, but they are somewhat different from those of *M. hoerensis* in having twice or thrice branched veins instead of once branched ones.

The pinna base of *Marattia asiatica* differs from that of *M. muensteri* which has not lobes as clearly shown by BARTHOLIN (1892, pl. 9, fig. 9).

In addition, *Marattia asiatica* is distinguished from *M. anglica* by that first *M. anglica* has asymmetrically constricted pinna base instead of cordate one in *M. asiatica*, secondly in *M. anglica*, the ratio of synangial length to width of laminae are, according to HARRIS (1961), from 1/2.3-1/5.6 instead of 1/3.3-1/10 in *M. asiatica*.

Marattiopsis crenulatus originally described by LUNDBLAD (1950) from the Upper Triassic of Northwestern Scania, is distinguished from *M. asiatica* by having crenulate margins of pinnae and smaller number of veins (9 per cm).

KILPPER (1964) adopted *Marattia intermedia* (MÜNSTER) instead of *M. muensteri*, because *Taeniopteris intermedia*, the source of *M. intermedia* was instituted by MÜNSTER in 1836 earlier than the institution of *Taeniopteris muensteri*, the source of *M. muensteri* by GOEPPERT in 1843. KILPPER included most of the specimens regarded as *Marattia* (or *Marattiopsis*) *muensteri*, *M. hoerensis* and *M. anglica* in Europe into his *M. intermedia* as synonyms. Setting aside his taxonomic treatment, his specimens illustrated from the Lias of North Iran as *M. intermedia* are similar in the shape of pinnae including basal lobes and the length of synangia (2-10 mm) to those of *M. asiatica*. But KILPPER's specimens have rather coarser veins (8-16 per cm) than those of *M. asiatica* (12-18 per cm).

The pinna fragments illustrated by CHANG (1976) as *Marattia hoerensis* from the Shiguai Group (Lower-Middle Jurassic) in Neimeng of China are, according to CHANG, 10-27 mm wide with veins in concentration of 12 per cm and synangia being 3-5 mm long. Although their pinna bases have not been known, his specimens might be distinct from *Marattia asiatica* and be referable to *M. anglica* rather than to *M. hoerensis*, because their ratios of synangial length to width of lamina are usually larger and within 1/3-1/5, instead of 1/3.3-1/10 in *M. asiatica*.

Similar specimens regarded as *Marattia hoerensis* were illustrated by FENG et al. (1977) from the Xiangxi Formation (Lower-Middle Jurassic) in Hubei of China. They appear to be different from those illustrated by SZE & HSÜ (1954) as *Marattiopsis* cfr. *muensteri* (=*M. asiatica* in this work),

because in the former specimens veins are 12 per cm instead of 15-18 per cm in the latter ones.

Marattiopsis litangensis originnally illustrated by YANG (1978) from the Upper Triassic of Western Sichuan of China differs from *Marattia asiatica* because YANG's species is characterized by its crenulate margins and less crowded veins (about 10 per cm).

The range of variation in the pinnae of one species overlaps the range of another species and it may thus be impossible to determine just a few pinna fragments.

Family Osmundaceae

Genus *Todites* SEWARD, 1900 : 86

Three *Todites* species were recognized, among which *T.* cfr. *denticulatus* and *T. fastuosus* belonged to the *Cladotheca* group and *T. neiridaniensis* to the *Todites williamsoni-goeppertianus* group defined by HARRIS (1931, 1937, 1961).

Todites cfr. *denticulatus* (BRONGNIART) KRASSER

Pl. 54, Flgs. 2-3; Pl. 55, Fig. 4; Pl. 56, Figs. 1-2; Text-figs. 2a-f

Comparable specimens: *Todites denticulatus* (BRONGNIART) KRASSER : HARRIS, 1961, p. 78, text-figs. 25-27 (Yorkshire).

Material: Fertile specimens; NE-091, 093, 094, 097, 098 (Neiridani). Sterile specimens; NE-007, 133, 154 and other 5 specimens (Neiridani), NNW-076, 410, 411, 684 and other 66 specimens (Nishi-Neiridani), NEE-019 and other 5 specimens (Higashi-Neiridani), NEG-023 and other 5 specimens (Negoyadani), A-0331 and other 23 specimens (Iwamuro). Besides above 10 sterile specimens were obtained from Kawagurodani, Dairagawa, Shinadani, Tobiiwadani, Tsuchizawa and Kotaki Coal-Field.

Description.—Over 130 leaf-fragments including 5 fertile ones were obtained. They represent various parts of the leaf, but the whole leaf is not known.

Sterile and fertile leaves are separate, although they are of similar size and form but the pinnules are dimorphic.

The rachis is thick, up to 8.5 mm wide, rounded below, but with a strong ridge on the upper side. Sterile pinnae are closely set, touching each other laterally, and arise alternately at an angle of about 50 degrees, then bending outwards and typically at intervals of about 4 cm at the middle of leaf. Pinnae are long and narrow, about 15 cm long at the middle of leaf and 3.5-4 cm wide near the pinna base, narrowing gradually towards the acuminate apex (Pl. 56, Fig. 1).

Sterile pinnules are arranged katadromically, arising at an angle of 75 degrees on the lower part of leaf, but the angle reducing upwards. Sterile pinnules differ in form in different leaves or in different positions of leaf, and are typically oblong with pointed apex, often falcate. The margins are dentate. Typical size of sterile pinnules is 1.7 cm long (range noted 0.8-2.5 cm, except those on the apical part of leaf or pinnae) and 0.6 cm wide (range noted 0.4-1.0 cm). The midrib is distinct, persisting to the tip and sending off 11-14 pairs (range noted 11-17) of branch veins forking once. The first pair or first basiscopic one is rarely forking twice.

In fertile leaves, pinnules are set rather remotely, arising nearly perpendicularly and are oblong in form with rounded apex, often falcate, but those on the apical part of pinnae are semi-circular (Pl. 54, Fig. 2). Typical size of oblong pinnules is 1.3 cm long and 3.5 mm wide. The margins are crenulated and the

midrib is distinct, persisting near the tip, sending off 6-7 pairs of branch veins which are simple or forked once.

Sporangia are rather large, 400 μm in diameter, ovoid and whole apical third of wall is composed of thickened cells, borne in a single file along each veins (Text-fig. 2e). Spores are not known.

In about half the fertile specimens, the upper surface of pinnules is strongly marked by the transverse waves (Pl. 54, fig. 3; Pl. 56, fig. 2; Text-fig. 2f) as shown by HALLE (1911), WALTON (1923) and HARRIS (1961, text-figs. 27A, B, D).

Distribution and occurrence. — *Todites* cfr. *denticulatus* is abundant in the Negoya Formation (Neiridani, Higashi-Neiridani, Nishi-Neiridani, Negoyadani, Kawagurodani) and Tsuchizawa of the Kuruma Group and Iwamuro Formation, but is rare in the Shinadani Formation (Shinadani and Tobiiwadani).

Todites cfr. *denticulatus* may also occur from to the Upper Triassic plant-beds in Japan.

Discussion and comparison.—Our specimens resemble closely those described by HARRIS (1961) from the Middle Jurassic of Yokshire, but somewhat differ in some minor points from the Yorkshire specimens. Differences are: In our specimens, typical size of sterile pinnules is 1.7 cm long but that of Yorkshire specimens is 2.5-3 cm long. In our specimens the triangular basal pinnules as shown by HARRIS (1961, text-fig. 26A, B) have not been found. No cellular pits covering the upper surface of pinnules as seen in the Yorkshire specimens, have been observed in our specimens.

Thus we hesitate the full identity of our specimens to *Todites denticulatus*.

From Japan many sterile leaves have been described under the name of *Cladophlebis denticulata* as follows:

YABE, 1922, p. 9, pl. 2, fig. 1; text-fig. 7 (Upper Triassic? Shitaka Group); pl. 2, fig. 2 (Lower Jurassic Toyora Group?).

OISHI, 1931, p. 233, pl. 1, fig. 5, 5a (Tsuchizawa, Kuruma Group); 1932, p. 288, pl. 11, figs. 3-7 (Noric Nariwa Group); 1940, p. 256, pl. 48, fig. 1 (Lower Cretaceous Oguchi Formation).

OISHI & TAKAHASHI, 1936, p. 118, pl. 1, fig. 2 (Carnic Yamanoi Formation).

KIMURA, 1959a, p. 13, pl. 3, fig. 4; pl. 4, figs. 3, 6; pl. 5, fig. 1; pl; 12, fig. 10; text-fig. 8 (Iwamuro Formation); 1959b, p. 68, pl. 1, fig. 4 (Kotaki Coal-Field, Kuruma Group); 1975, p. 78, pl. 5, fig. 11; pl. 6, fig. 5; figs. 4-5a, b (regarded as *C.* ex gr. *denticulata*; Lower Cretaceous formations in Fukui Prefecture).

KIMURA & KANSHA, 1978, p. 111, pl. 4, fig. 2; text-fig. 4 (regarded as *C.* ex gr. *denticulata*; Lower Cretaceous of SW-Japan).

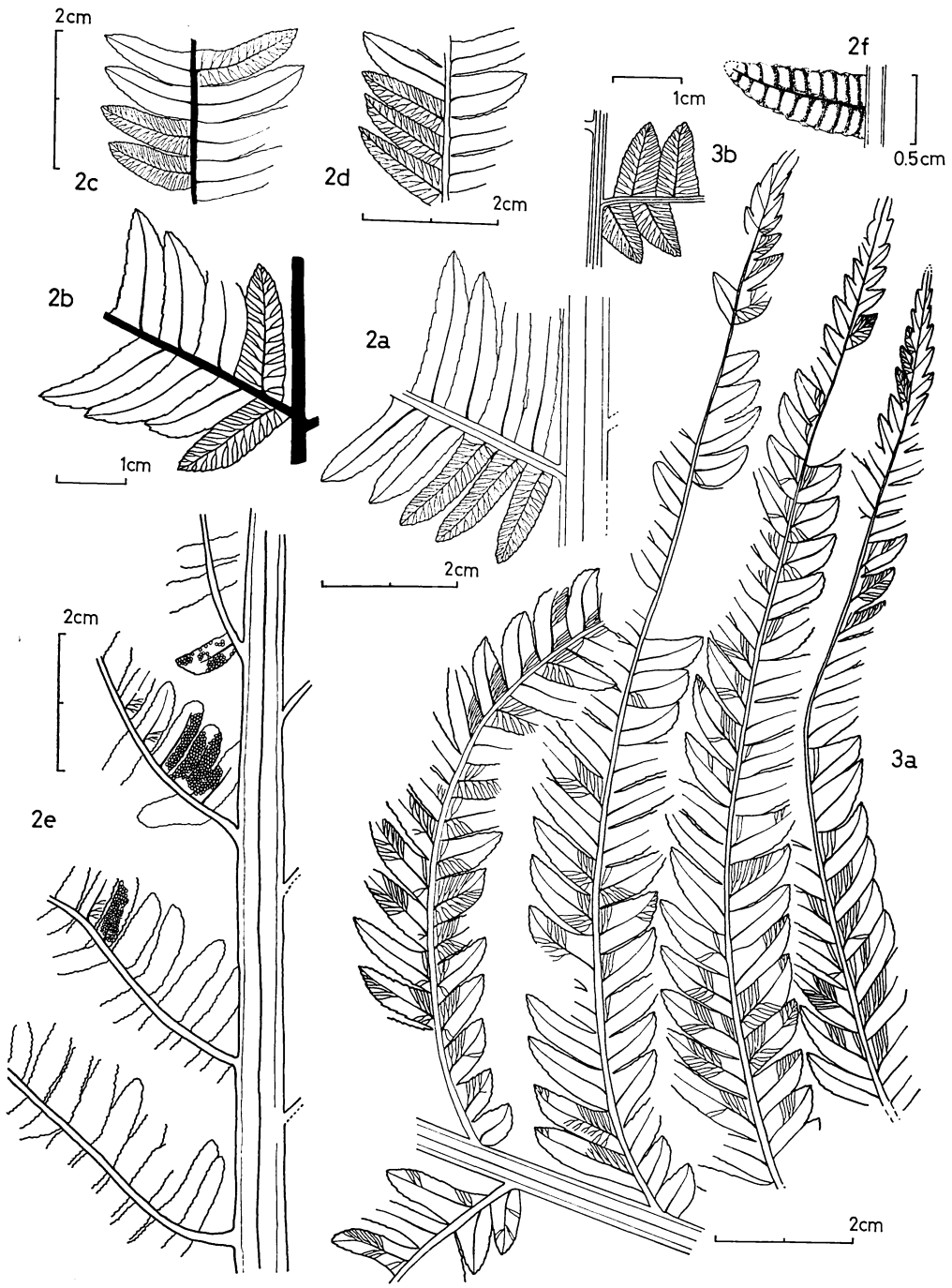
Among them the specimens excluding the Lower Cretaceous ones, are externally indistinguishable from our sterile leaves, although most of pinnules, except ones from the Nariwa Group and the Yamanoi Formation, appear to be entire. The Lower Cretaceous pinnules are generally far smaller in size and with entire margins.

As previously mentioned (KIMURA & OHANA, 1980), the fertile pinnules from the Carnic Momonoki Formation, regarded by TAKAHASHI (1950, figs. 3-5) as *Todites recurvatus*, are referable to *Todites* cfr. *denticulatus*.

Fragments of sterile leaves of *Todites* cfr. *denticulatus* may be indistinguishable from those of *T. fastuosus*.

Todites fastuosus (KIMURA) KIMURA and TSUJII comb. nov.

Pl. 54, Figs. 4-6; Pl. 55, fig. 5; Pl. 56, Figs. 3-4; Text-figs. 3a-h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Cladophlebis fastuosa KIMURA: KIMURA, 1959a, p. 15, pl. 3, figs. 1-3; pl. 4, figs. 2, 10; pl. 5, fig. 5; pl. 12, fig. 11; Text-fig. 9 (Iwamuro).

Cladophlebis haiburnensis (LINDLEY & HUTTON) BRONGNIART: KIMURA, 1959a, p. 16, pl. 4, fig. 8; pl. 6, figs. 3, 5, 7, text-fig. 10 (Iwamuro).

Material: Lectotype; A-0468 (Iwamuro). Paralectotypes; NNW-556 (fertile pinna), 486 (Nishi-Neiridani), A-1013 (Iwamuro), NEG-078 (Negoyadani). NE-003 and other 11 specimens (Neiridani), NEE-001 and other 34 specimens (Higashi-Neiridani), NNW-020 and other 51 specimens (Nishi-Neiridani), A-032 and other 120 specimens (Iwamuro). Besides the above 23 specimens were obtained from Negoyadani, Dairagawa, Kawagurodani, Sasakomata, Shinadani, Tobiiwadani, Tsuchizawa and Kotaki Coal-Field. *Locus typicus*: Iwamuro, Shirasawa-mura, Toné-gun, Gumma Prefecture. *Stratum typicum*: Lower Jurassic Iwamuro Formation. *Derivatio nominis*: This species was first named on the basis of very finely preserved (fastuous) specimens from the Iwamuro Formation.

Diagnosis.—Frond bipinnate. (Whole leaf unknown.) Probably wholly fertile of wholly sterile. Rachis considerably thick, 0.5 cm wide, with longitudinal fine striations on its surface. Pinnae arising alternately at an angle of 35-40 degrees, 2.6-2.8 cm distant at the middle of leaf. Pinna rachis up to 2 mm wide, widest at base. Pinna as a whole almost uniformly wide up to near its acutely pointed apex. Pinnules katadromic in order, differing in different leaves, set closely, often overlapping, typically triangular or elongate-triangular, apex often falcate or curved forwards, typically arising at 50-60 degrees to the pinna rachis, apex pointed. Typical size of pinnules 1.5 cm long and 0.8 cm wide at base; basal basiscopic margin usually contracted and basal acroscopic margin expanded. The first basiscopic pinnule arising at the base of pinna rachis; smaller in size and deltoid in form; sometimes no pinnule opposite this but first acroscopic pinnule opposite second basiscopic one. Pinnule margins finely dentate, midrib distinct, arising at the point close to basiscopic margin of pinnule, persisting to the tip, sending off 7-15 pairs of branch veins, but 4-6 pairs on the apical small pinnules. In large pinnules, the first branch vein forking thrice, basal 3-5 pairs forking twice and others forking once. In medium-sized pinnules, basal 1-2 pairs of branch veins forking twice and others forking once. In small-sized pinnules they forking once. The branch veins on the acroscopic side longer than those on the basiscopic side and usually parallel to the pinna rachis.

Fertile pinnules similar in all features to sterile ones but smaller in size, with

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Text-figs. 2a-f. *Todites* cfr. *denticulatus* (BRONGNIART) KRASSER

2a. A part of sterile frond with typical pinnules; the first basiscopic pinnule is not specialized; surface view; drawn from NNW-411 (Pl. 55, Fig. 4) (Nishi-Neiridani).

2b. An anterior part of sterile frond; back-side view. NEG-023 (Negoya).

2c. A part of sterile pinna; back-side view. NNW-076 (Nishi-Neiridani).

2d. Ditto. NNW-684 (Nishi-Neiridani).

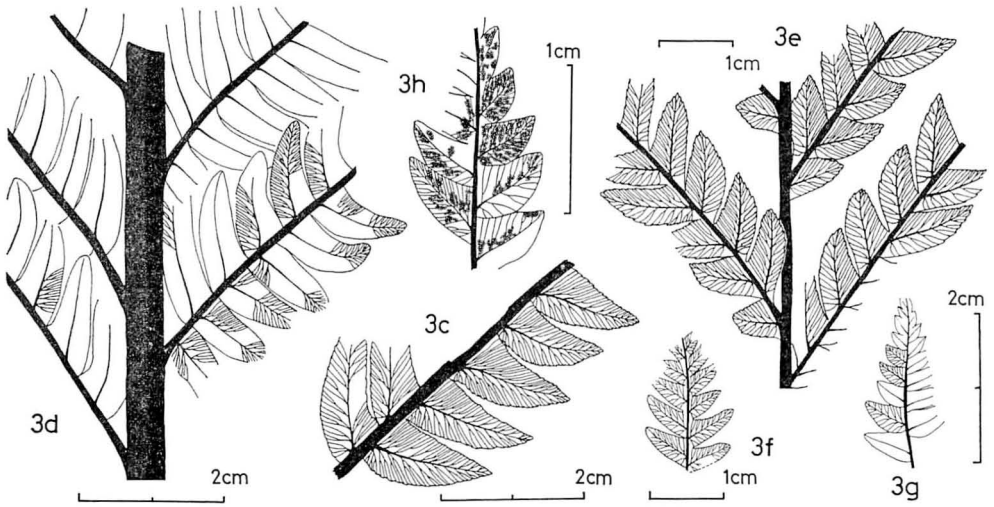
2e. A part of fertile frond with thick rachis; from NE-098 (Pl. 56, Fig. 2) (Neiridani).

2f. A fertile pinnule; surface view; its upper surface is strongly marked by the transverse waves; drawn from NE-097 (Neiridani).

Text-figs. 3a-b. *Todites fastuosus* (KIMURA) KIMURA and TSUJII comb. nov.

3a. A part of sterile frond; the first acroscopic pinnule is lacking in each pinna; surface view. NNW-464 (Nishi-Neiridani).

3b. A part of sterile frond with small-sized pinnules; surface view. NNW-040 (Nishi-Neiridani).



Text-figs. 3c-h. *Todites fastuosus* (KIMURA) KIMURA and TSUJII comb. nov.

3c. A part of sterile pinna with typical pinnules; back-side view; drawn from the lectotype, A-0468 (Iwamuro) (Pl. 54, Fig. 4).

3d. A part of sterile frond with thick rachis; back-side view; margins of pinnules were rolled down. NNW-486 (Nishi-Neiridani).

3e. An anterior part of sterile frond; back-side view; drawn from the paralectotype, NEG-078 (Negoya).

3f. Apical part of sterile pinna; margins of pinnules were rolled down. NNW-585 (Nishi-Neiridani).

3g. Ditto; margins of pinnules were rolled down. NNW-538 (Nishi-Neiridani).

3h. A part of fertile pinna; margins of pinnules were rolled down; drawn from the paralectotype, NNW-556 (Pl. 54, Fig. 6) (Nishi-Neiridani).

5-9 pairs of branch veins forking once or twice. Sporangia borne in a single file along both sides of each vein. Sporangia small, 0.1-0.15 mm in diameter. (Detail of sporangium and spore not known.)

Distribution and occurrence. — Very abundant in the Iwamuro Formation and the Negoya Formation (Kuruma Group), but rather rare in the Shinadani Formation (Kuruma Group). This species possibly occurs also from the Upper Triassic formations in Japan.

Discussion and comparison.—One of us (KIMURA) first described *Cladophlebis fastuosa* from the Iwamuro Formation in 1959. Afterwards we had thought that the diagnosis of this species should be emended on the basis of further specimens obtained from the Iwamuro Formation and the Kuruma Group. Now it is apparent that they belong to *Todites* (*Cladotheca* group), because recently we found several fertile pinna fragments in our collection.

Todites fastuosus is characterized by its medium-sized triangular pinnules with finely dentate margins and with thrice forking branch veins in part.

Todites fastuosus differs from *T. denticulatus* (BRONGNIART), although some pinnules resemble in form and venation those figured by HARRIS as *T. denticulatus*, such as his figs. 25F and 26B (1961). Main differences are: In *T. fastuosus* the

fertile pinnules are similar in form and venation to sterile ones, while in *T. denticulatus* the fertile pinnules are oblong, with bluntly pointed apex and mostly with simple branch veins. Moreover in sterile pinnules of *T. fastuosus*, branch veins are thrice to once forking, while in *T. denticulatus*, they are mostly once forking.

Todites fastuosus is distinguished from *T.* cfr. *denticulatus* here described together by its fertile pinnules and the venation of sterile pinnules. In *T.* cfr. *denticulatus*, branch veins of sterile pinnules are always forking once and the fertile pinnules differ in form from sterile ones.

The sterile pinnules of the Greenland species, *Todites hartzi* HARRIS resemble in form and venation those of *T. fastuosus*, but the fertile pinnules differ in form from each other.

Several sterile pinna fragments described by KIMURA (1959a) as *Cladophlebis haiburnensis* belong to *Todites fastuosus*. *Cladophlebis tenue* originally described by OISHI & HUZIOKA (1938, p. 74, text-fig. 1a-b) based on a single sterile leaf-fragment, resemble *Todites fastuosus* in that its midribs are usually close to the basiscopic base of pinnule.

Small sterile fragments of *Todites fastuosus* may be impossible to distinguish from those of other *Cladophlebis* species.

Todites neiridaniensis KIMURA and TSUJII sp. nov.

Pl. 55, Figs. 6-7; Pl. 56, Fig. 5; Text-figs. 4a-d

Todites goeppertianus (MUENSTER) KRASSER: OISHI, 1940, p. 194 (pars), pl. 3, fig. 1, 1a (Neiridani).

Material: Holotype; NEE-110. Paratypes; NEE-020, 100, 314 (Higashi-Neiridani), NNW-222, 729 (Nishi-Neiridani), A-005 (Iwamuro). NEE-022 and other 10 specimens, NNW-328 and other 12 specimens, NE-105 and other 1 specimen (Neiridani), NEG-036 and other 2 specimens (Negoyadani). *Locus typicus*: The Higashi-Neiridani, a branch of the Dairagawa, Asahi-machi, Shimo-Niikawa-gun, Toyama Prefecture. *Stratum typicum*: Negoya Formation of Kuruma Group. *Derivatio nominis*: This species is named after the Neiridani where the holotype was collected.

Diagnosis.—Leaves wholly sterile or wholly fertile, bipinnate (but whole leaf not known). Rachis thick, up to 9 mm wide, grooved above, rounded below. Pinnae arising alternately at an angle of 45-50 degrees, 1.7-2 cm distant, flexuous. Pinna rachis up to 2 mm wide, widened at base, channelled above. Pinna as a whole almost uniformly wide up to near its apex. Both sterile and fertile pinnules katadromic in order, differing in different leaves, set closely, often overlapping, ovoid, semi-circular or oblong in form, often curved forwards, commonly arising at right angles to the pinna rachis. The first pinnule always borne near the main rachis but not specialized. Typical sterile pinnules 5 mm long and 5 mm wide, basal margin often contracted, upper (acroscopic) margin often slightly expanded at pinna rachis; lateral margins entire, apex broadly rounded. Venation neuropterid. Midrib arising from the middle of pinnule base, distinct in its basal half. Branch veins irregularly forked. Typically first basiscopic branch veins arsing from the base of midrib or from the pinna rachis, forked 3-4 times, the first acroscopic branch veins and next two pairs forked twice, the rest once or simple. Branch veins on the acroscopic side arising from the midrib at a wide angle but those on the basiscopic side usually directed forwards.

Fertile pinnules similar in size, form and venation to sterile ones. Sporangia

usually covering whole under surface apart from the marginal zone, borne in a single file along each vein. Sporangia ovoid, whole apical third of wall composed of thickened cells, 200-250 μm in diameter. (Spore unknown.)

Distribution and occurrence. — *Todites neiridaniensis* is locally abundant in the Negoya Formation (Kuruma Group). A single specimen was obtained from the Iwamuro Formation.

Discussion and comparison. — *Todites neiridaniensis* is characterized by its closely set pinnules with broadly rounded apex and entire margins, and its sporangia covering whole under surface except the marginal zone of pinnule.

Todites neiridaniensis belongs to the *T. williamsoni-goeppertianus* group because of its neuropterid venation. *Todites neiridaniensis* is distinguished as follows from the European species, *T. williamsoni* (BRONGNIART) SEWARD to which detailed emended diagnosis was given by HARRIS (1961). In *T. williamsoni*, sterile pinnules are, according to HARRIS, usually larger in size, with acutely pointed apex and lobed margins in larger pinnules or dentate near the apex in exceptional cases, instead of smaller pinnules with broadly rounded apex and entire margins in *T. neiridaniensis*. In *T. williamsoni*, fertile pinnules are usually smaller in size than sterile ones, but both are similar in size and form in *T. neiridaniensis*. In *T. williamsoni*, sporangia cover whole under surface, but not on the marginal zone in *T. neiridaniensis*.

Todites neiridaniensis is also distinguished from the European Rhaeto-Liassic species, *T. goeppertianus* (MUENSTER) KRASSER. In *T. goeppertianus*, fertile pinnules are more elongated, typically 7 mm long and 4 mm wide (HARRIS, 1931) and sterile ones are also more elongated and larger in size, typically 10 mm long and 5 mm wide, than those of ours. In *T. goeppertianus*, most of fertile pinnules are, according to the illustrations made by HARTZ (1896) and HARRIS (1931), about 1 mm narrower near the base than at the middle. Such coarctated pinnules have not been found in *T. neiridaniensis*. Moreover, in *T. goeppertianus*, the sterile pinnules at the top of leaf and near the distal ends of pinnae, are pointed at apex, but such apices have not been found in *T. neiridaniensis*.

Both sterile and fertile leaves described by ZEILLER (1903) from the Upper Triassic of North Viet-Nam as *Cladophlebis* (*Todea*) *roesserti*, is also distinguished from *T. neiridaniensis* by having more elongated sterile pinnules and the fertile pinnules

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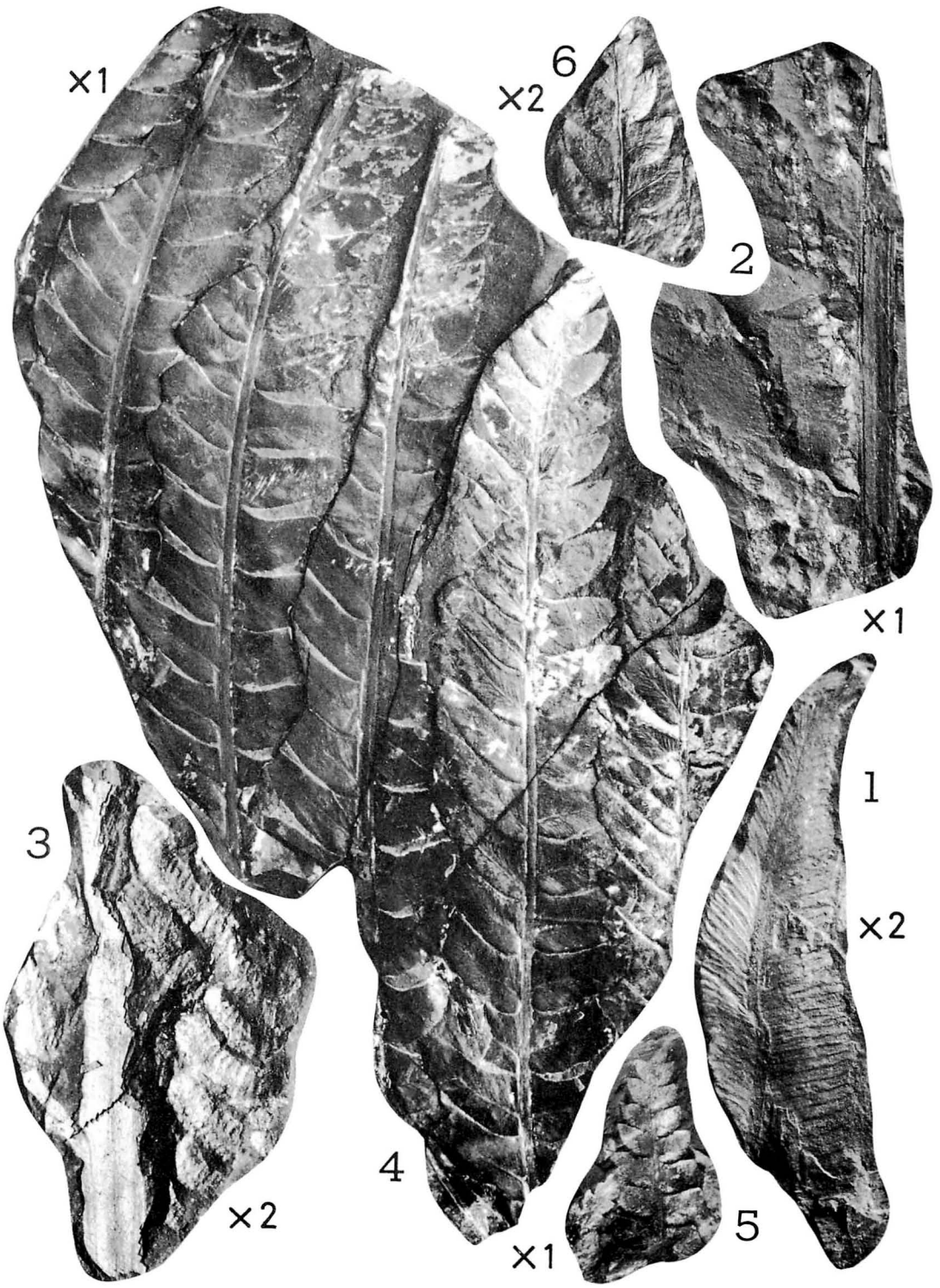
Explanation of Plate 54

Fig. 1. *Marattia asiatica* (KAWASAKI) HARRIS
Apical part of fertile pinna. NEE-133 (Higashi Neiridani).

Figs. 2, 3. *Todites* cfr. *denticulatus* (BRONGNIART) HARRIS
2. Fertile frond with small-sized and semi-circular pinnules. NE-091 (Neiridani).
3. Fertile frond with oblong pinnules of which upper surface is transversely waved. NE-093 (Neiridani).

Figs. 4-6. *Todites fastuosus* (KIMURA) KIMURA and TSUJII comb. nov.
4. A part of sterile frond; pinnules with thrice to once forking branch veins (see Text-fig. 3c). A-0468 (lectotype), collected by N. SASAKI.
5. Apical part of pinna. A-1026 (Iwamuro).
6. Fertile pinna fragment (see Text-fig. 3h). NNW-556 (paralectotype) (Nishi-Neiridani).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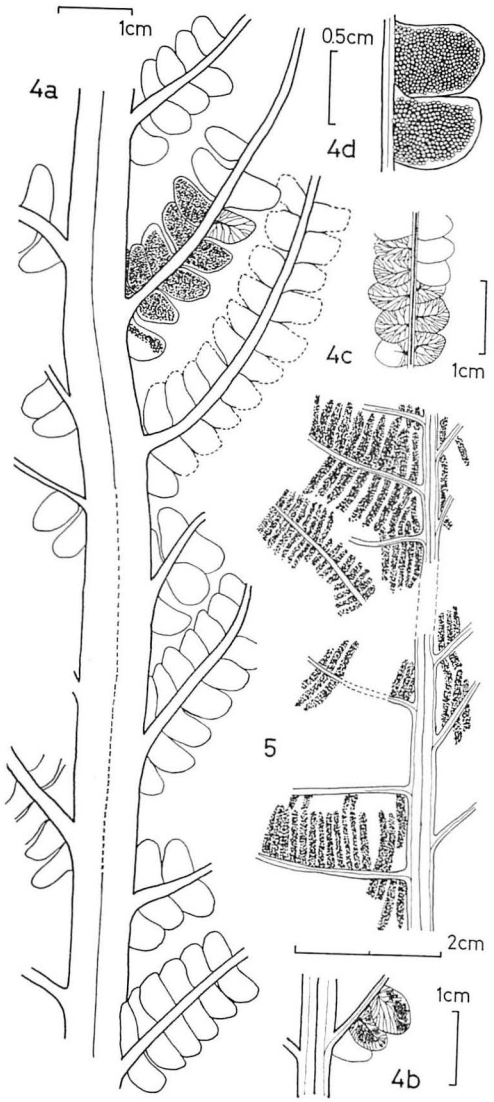

often coarctated. ZEILLER's species appears to be much close to *Todites goeppertianus*, as formerly pointed out by HARRIS (1931) and OISHI (1940).

OISHI (1940) described a pinna fragment with six pairs of fertile pinnules as *Todites goeppertianus* from the same locality as ours. It is possibly referable to *T. neiridaniensis*, but cannot be determined because the pinnule apices are missing.

OISHI's specimens from the Noric Nariwa Group regarded by him (1932) first as *Todites roesserti* ZEILLER and later (1940) as *T. goeppertianus*, are distinguished from those of *T. neiridaniensis* by having more elongated sterile pinnules.

OISHI (1932, 1940) referred YOKOYAMA's *Asplenium whitbiensis* BRONGNIART from Ozo of the Lower Cretaceous Oguchi Formation to *Todites williamsoni*. But in our opinion, YOKOYAMA's sterile leaves (1889, p. 31, pl. 3, fig. 3; pl. 10, figs. 1, 2a) are indeterminable, because their venation is unknown.

OISHI (1940) referred KAWASAKI's *Cladophlebis* (*Todites*) *williamsoni* BRONGNIART forma *whitbiensis* (1925, p. 21, pl. 4, fig. 13) and *C.* (*Todites*) *williamsoni* BRONGNIART (1925, p. 24, pl. 36, fig. 101) from the Daedong Group of Korea, to *T. williamsoni*. But as recently mentioned by KIMURA and OHANA (1980), these KAWASAKI's specimens do not belong to *T. williamsoni* because of their pecopterid

Text-figs. 4a-d. *Todites neiridaniensis* KIMURA and TSUJII sp. nov.

4a. A part of fertile frond with thick rachis; back-side view; drawn from the holotype, NEE-110 (Higashi-Neiridani).

4b. Ditto; showing the venation of pinnules; back-side view; drawn from the paratype, NNW-729 (Nishi-Neiridani).

4c. A part of sterile pinna; showing the venation of pinnules. NEE-020 (Higashi-Neiridani).

4d. A part of fertile pinna; showing the distribution of sporangia; drawn from the paratype, NNW-222 (Pl. 56, fig. 5) (Nishi-Neiridani).

Text-fig. 5. *Osmundopsis nipponica* KIMURA and TSUJII sp. nov.

A part of fertile frond; drawn from the holotype, NE-021 (Neiridani).

venation, but are indistinguishable from *T. yamanoiensis* (YOKOYAMA) KIMURA and OHANA.

KAWASAKI's *Cladophlebis williamsoni* BRONGNIART cfr. var. *tenuicaulis* THOMAS (1926, p. 26, pl. 7, fig. 21) also from the Daedong Group, is close to *Todites yamanoiensis*.

Thus, there is no specimen safely identified with *Todites williamsoni* in Japan and Korea.

Genus *Osmundopsis* HARRIS, 1931 : 136

Osmundopsis nipponica KIMURA and TSUJII sp. nov.

Pl. 55, Fig. 8; Text-fig. 5

Material: Holotype; NE-021 (Neiridani). Paratypes; NE-025, 066, 121. *Locus typicus*: The Neiridani, a branch of the Dairagawa, Asahi-machi, Shimo-Niikawa-gun, Toyama Prefecture. *Stratum typicum*: Negoya Formation of Kuruma Group. *Derivatio nominis*: This species is named after Nippon meaning Japan in Japanese.

Diagnosis.—Fertile leaves with a smooth, comparatively thick rachis, 3.5 mm wide, channelled above, alternately bearing slender primary branches at a wide angle and at intervals of 0.7-1.1 cm ; secondary branches katadromic in order, crowded, 1.5 mm distant, typically 7.5-8 mm long, touching or overlapping each other laterally, attached at right angles to the primary branch. Tertiary branches minute or suppressed, but covered with sporangia. Sporangia crowded, pyriform or obovate, about 400 μm in diameter measured on impression. Cells of whole apical region thickened. (Whole leaf, spores and sterile leaf unknown.)

Distribution and occurrence. — This species is only known from the Neiridani of the Negoya Formation (rather rare).

Discussion and comparison.—The present fertile leaves agree fully with the emended diagnosis of *Osmundopsis* given by HARRIS (1961), although no sterile leaf has been found in our collection.

Osmundopsis nipponica resembles *O. sturi* (RACIBORSKI) HARRIS known from the Lower Jurassic of Poland (RACIBORSKI, 1894) and the Middle Jurassic of Yorkshire (HARRIS, 1961), but so far as RACIBORSKI's illustrations are concerned, it is somewhat

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Explanation of Plate 55

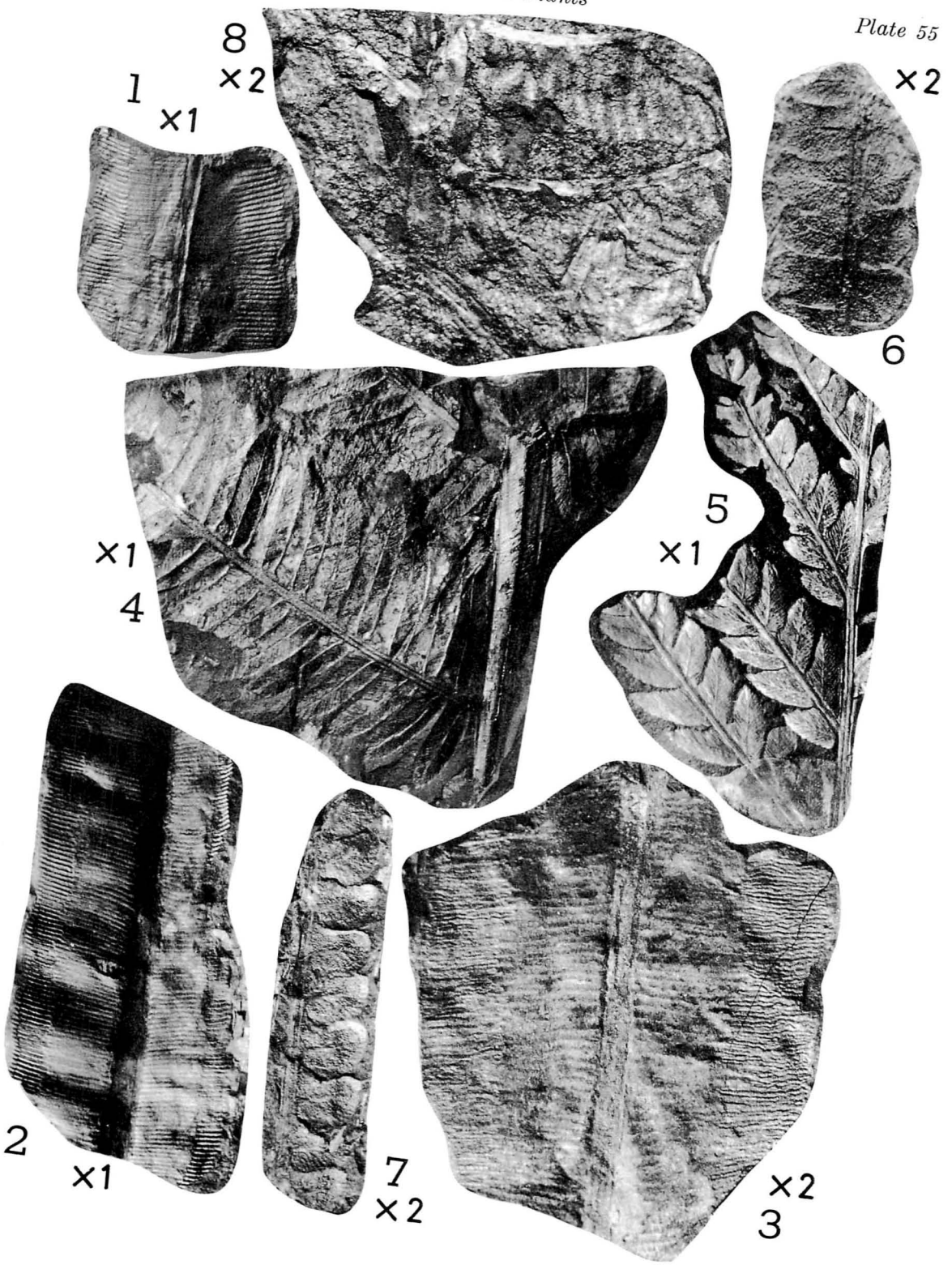
Figs. 1-3. *Marattia asiatica* (KAWASAKI) HARRIS
1. A pinna fragment with longer synangia; the ratio of synangial length to width of lamina is 1/4.6. NNW-415 (Nishi-Neiridani).
2. A pinna fragment with shorter synangia; the ratio of synangial length to width of lamina is 1/8. NNW-816 (Nishi-Neiridani).
3. A pinna fragment with longer synangia; the ratio of synangial length to width of lamina is 1/5.2. A-0494 (see Text-fig. 1f) (Iwamuro).

Fig. 4. *Todites* cfr. *denticulatus* (BRONGNIART) KRASSER. A part of sterile frond with typical pinnules. NNW-411 (see Text-fig. 2a) (Nishi-Neiridani).

Fig. 5. *Todites fastuosus* (KIMURA) KIMURA and TSUJII comb. nov. Apical part of sterile frond. A-060 (paralectotype) (Iwamuro), collected by N. SASAKI.

Figs. 6,7. *Todites neiridaniensis* KIMURA and TSUJII sp. nov.
6. A part of holotype (see Text-fig. 4a). NEE-110 (Higashi-Neiridani).
7. A part of fertile pinna. NEE-100 (Higashi-Neiridani).

Fig. 8. *Osmundopsis nipponica* KIMURA and TSUJII sp. nov. A part of fertile frond. NE-025 (paratype) (Neiridani).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different from *O. sturi* in that our secondary branches are less elongated and very crowed, and our sporangia are rather smaller in size, instead of more longer and remotely set secondary branches, and more or less larger sporangia in *O. sturi*. Our main rachis is thicker than that of *O. sturi*.

Osmundopsis plectrophora HARRIS known from the Liassic of Greenland (HARRIS, 1931) and *O.* cfr. *plectrophora* from the Liassic of North Iran (KILPPER, 1964), are distinguished from *O. nipponica* by their longer tertiary branches and large-sized spherical sporangia (600 μm in diameter) in clusters.

KIMURA (1975) described two fertile and several sterile leaf-fragments as *Osmundopsis*? sp. from the equivalent of Lower Cretaceous Kitadani Formation in the Inner Zone of Central Japan. The fertile leaves of *O.*? sp. are safely distinguished from those of *O. nipponica* by its fairly shorter and remotely set secondary branches.

Repository.—All specimens here described are kept in the Department of Astronomy and Earth Sciences, Tokyo Gakugei University.

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Explanation of Plate 56

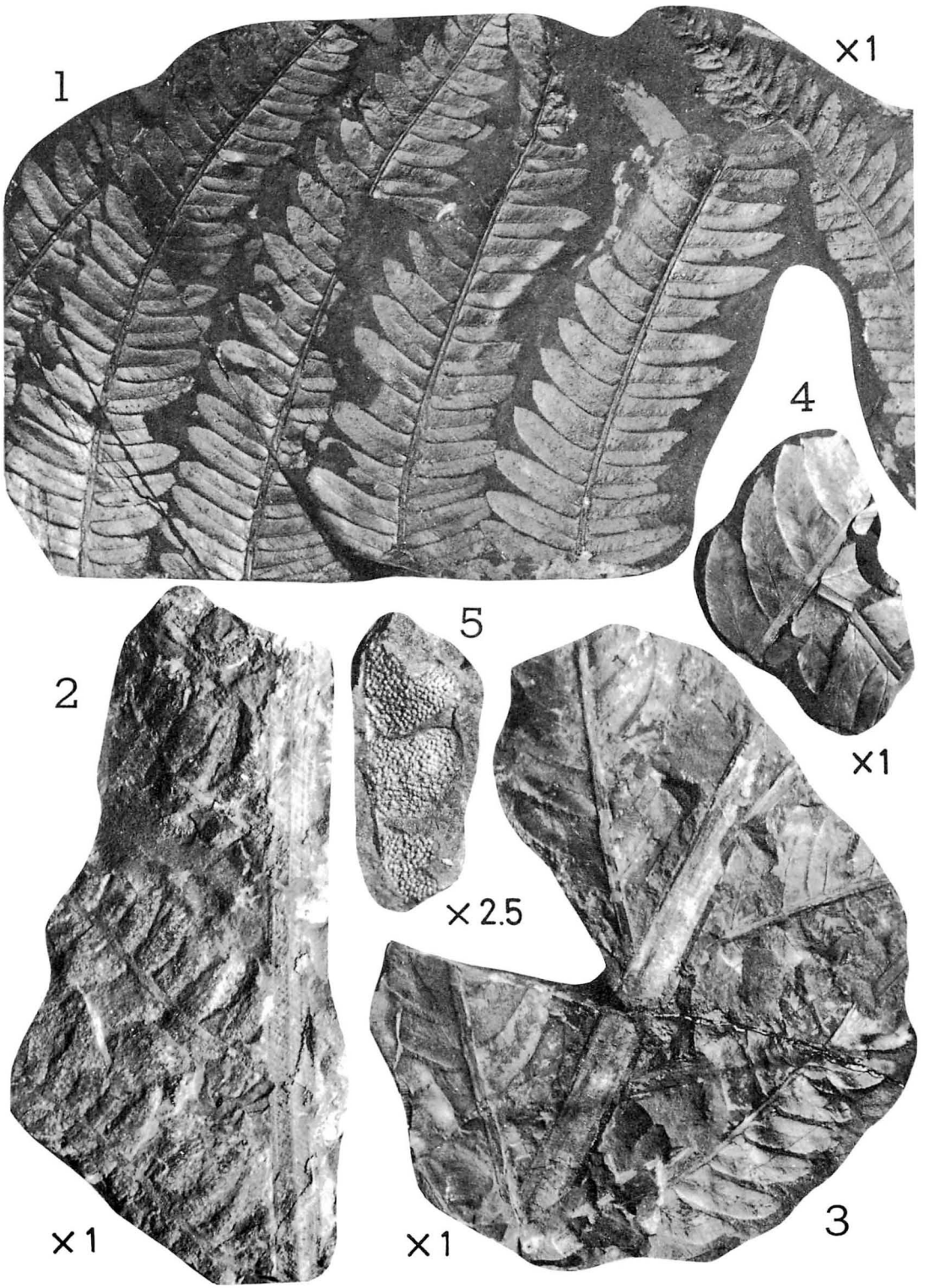
Figs. 1, 2. *Todites* cfr. *denticulatus* (BRONGNIART) KRASSER

1. A part of sterile frond with typical pinnules. NNW-076 (Nishi-Neiridani).
2. A part of fertile frond with oblong pinnules of which upper surface is transversely waved. NE-098 (Neiridani).

Figs. 3-4. *Todites fastuosus* (KIMURA) KIMURA and TSUJII comb. nov.

3. A part of sterile frond with thick rachis. NE-029 (Neiridani).
4. A part of sterile pinna, showing typical pinnules. A-2008 (Iwamuro).

Fig. 5. *Todites neiridaniensis* KIMURA and TSUJII sp. nov. A part of fertile pinna, showing sporangia on the lower surface of pinnules, except their marginal zones. NNW-222 (Nishi-Neiridani).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Asahi-machi 朝日町, Daedong 大同, Dairagawa 大平川, Fukui 福井, Higashi-Neiridani 東寝入谷, Hubei 湖北, Iwamuro 岩室, Kawagurodani 川黒谷, Kitadani 北谷, Kotaki 小滝, Kuruma 来馬, Momonoki 桃ノ木, Nariwa 成羽, Negoya 似虎谷, Neimung 内蒙, Neiridani 寝入谷, Nishi-Neiridani 西寝入谷, Oguchi 尾口, Ozo 尾添, Sasakomata 笹小俣, Shiguai 石拐, Shimo-Niikawa-gun 下新川郡, Shinadani 榀谷, Shitaka 志高, Sichuan 四川, Tobiiwadani 飛岩谷, Toyora 豊浦, Tsuchizawa 土沢, Xiangxi 香溪, Yamanoi 山野井, Yipinglang 一平浪, Yunnan 雲南

日本の初期ジュラ紀植物化石。その2：来馬層群および岩室累層から，実葉の発見と多くの資料とをもとにして，りゆうびんたい科およびぜんまい科に属するつぎのシダ化石を記載した。

Marattia asiatica (KAWASAKI) HARRIS (りゆうびんたい科), *Todites* cfr. *denticulatus* (BRONGNIART) KRASSER, *T. fastuosus* (KIMURA) KIMURA and TSUJII comb. nov., *T. neiridaniensis* KIMURA and TSUJII sp. nov. および *Osmundopsis nipponica* KIMURA and TSUJII sp. nov. (以上ぜんまい科)。以上の *Todites* 種のうち，*T.* cfr. *denticulatus* および *T. fastuosus* は *Cladotheca* group に，*T. neiridaniensis* は *T. williamsoni-goeppertianus* group に属する。

木村達明・辻井正則

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 120, p. 466, December 30, 1980

SHORT NOTES

19. *VENERICARDIA (CYCLOCARDIA) TAKEDAI*, NEW NAME FOR *VENERICARDIA (CYCLOCARDIA) ELLIPTICA* TAKEDA, 1953 (PREOCCUPIED)*

YUTAKA HONDA

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Kamihama, Tsu 514

During the course of a study of molluscan fossils from the Urahoro and Ombetsu Groups in the Kushiro coal field, eastern Hokkaido, it was realized that *Venericardia (Cyclocardia) elliptica* TAKEDA (1953, p. 80, pl. 8, figs. 13, 18; pl. 11, figs. 7-12, 14-23; pl. 12, figs. 6, 20, 24), originally described from the Poronai Formation of central Hokkaido, and the Ombetsu Group, is preoccupied by *Venericardia elliptica* DOUVILLÉ (1928, p. 21, pl. 4, figs. 26-33) from the *Cardita beaumonti* Bed (Paleocene) of India. *V. elliptica* DOUVILLÉ was brought to Japanese paleontologists' attention by MIZUNO (1964), but the invalidity of *V. elliptica* TAKEDA has not been noted previously. The new name *Venericardia (Cyclocaradia) takedai* is proposed for *Venericardia (Cyclocardia) elliptica* TAKEDA. The author wishes to thank Dr. Alan G. BEU, New Zealand Geological Survey for reading the manuscript.

* Received October 14, 1980

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PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

学 会 記 事

日本古生物学会 第126回例会が1980年10月10日(金)—12日(日)に富山市科学文化センターで開催された。(参会者94名)

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瀬戸内区の中新世古地理と古生物地理 ..... 糸魚川淳二・柴田 博
中新世の *Geloina—Telescopium* fauna と古環境 ..... 津田禾粒
初—中期中新世の大型有孔虫古動物地理区および古環境について .....松丸国照
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現在の熱帯性沿岸域における地域生態系 ..... 堀越増興

個 人 講 演

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富山県入善町吉原沖埋没林について ....藤井昭二

公開講演会(地元同好会と共催)

富山が熱帯性気候であったころ —1500万年前の時代 .....津田禾粒
氷河・埋没林・サンゴ礁 .....小西健二

なお，10月10日夕に富山市職員会館において懇親会が，10月12日には八尾地方への巡検が行われ，共に盛会であった。

日本古生物学会特別号の原稿募集

PALAEONTOLOGICAL SOCIETY OF JAPAN, SPECIAL PAPERS, NUMBER 25 を 1982 年度に刊行したく，その原稿を公募します。適当な原稿をお持ちの方は，次の事項に合わせて申込書を作成し，原稿の写しを添えて，〒812 福岡市東区箱崎 九州大学理学部地質学教室気付，日本古生物学会特別号編集委員会（代表者首藤次男）宛に申し込んで下さい。

(1) 古生物学に関する論文で，欧文の特別出版にふさわしい内容のもの。同一の大題目の下に数篇の論文を集めたもの（例えばシンポジュウムの欧文論文集）でもよい。分量は従来発行の特別号に経費上ほぼ匹敵すること。学会以外からも経費が支出される見込のある場合には，その金額に応じて上記よりも分量が多くてよい。

(2) 内容・文章ともに十分検討済の完成した原稿で，印刷所に依頼して正確な見積りを算出できる状態にあること。申込書とともに必ず原稿の写しを提出して下さい。（用済の上は返却致します）。

(3) 申込用紙は自由ですが，次の事項を明記し，〔 〕内の注意を守って下さい。

(a) 申込者氏名；所属機関または連絡住所・電話番号。〔本会会員であること〕。

(b) 著者名；論文題目。〔和訳を付記すること〕。

(c) 研究内容の要旨。〔800～1,200 字程度，和文で可〕。

(d) 内容ならびに欧文が十分検討済であることの証明。〔校閲者の手紙の写しでもよい〕。

(e) 本文の頁数（刷上り見込頁数または原稿で欧文タイプ 25 行詰の場合の枚数 — ただし，パイカーかエリート字体かを添記すること）；また本文中小活字（8 ポ組み）に指定すべき部分があるときは，そのおよその内訳（総頁に対するパーセント）；挿図・表の各々の数と刷上り所要頁数；写真図版の枚数。

(f) 他からの印刷経費支出の見込の有無，その予算額，支出源。〔その見込の証明となる書類またはその写しを添えて下さい〕。

(g) その他参考事項。

(4) 申込及び原稿提出締切 1981 年 6 月 30 日（必着）。採否は 編集委員会が必要に応じレフェリーと相談の上内定し，1982 年 1 月の評議員会で審議決定の上，申込者に回答の予定です。ただしその前または後に，申込者との細部の交渉を，編集委員から求めることがあるかもしれません。

(5) 上記 (f) の他からの印刷経費支出の見込みがない場合は，1982 年度の文部省刊行助成金（「研究成果刊行費補助金」）を申請いたしますので，上記 (2) の条件がみたされている場合にのみ考慮されます。

(6) 論文が完全な場合には，評議会での決定後できるだけ早く印刷にとりかかる予定です。文部省の刊行助成金の申請は，学会から行ない（例年は 11 月末に申請締切），その採否・金額など決定後印刷にとりかかります。その場合は文部省との約束により，その年の秋（前例では 10 月 20 日）までに初校が全部出なければ，補助金の交付が中止されることになっています。

(7) 特別号の原稿は会誌に準じ，前例を参考として作成して下さい。不明の点は編集委員会に問い合わせて下さい。経費がかかるので，特別な場合を除き，別刷は作成せず，本刷 25 部を著者に無料進呈します。それ以上は購入（但し著者には割引）ということになります。いくつかの論文を集めて 1 冊にするときには，世話人の方から指示して，体裁上の不統一のないようにして下さい。印刷上の指示事項が記入できるよう，原稿の左右両側・上下に十分空白をとって，タイプで浄書して下さい。

○文部省出版助成金が得られなかった場合には，出版を繰延べることがあるかもしれません。
○原稿の完全を期するため前年から締切日を早めることになりました。

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(1980年10月10日現在)

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凡　　例

1．名簿には，1980年夏に行ったアンケートおよび基礎資料から，各会員の氏名，入会年，所属機関名，現住所，自宅電話（勤務先の場合は *）および専門分野を記してある。
2．氏名はアイウエオ順に記し，氏名の前の * は特別会員を示す。
3．所属機関名および専門分野は誤解を生じない範囲で簡略化してある。
4．連絡先は原則として自宅住所を記入した。勤務先等である場合は，末尾に**同左**を付記した。
5．名簿末尾に，関係学会，関係研究機関，地質学古生物学関係教室・研究室および関係博物館の所在地（電話番号）を付した。なお，上記機関の所属の会員名を可能な限り収録し，索引の便に供した。

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高井　冬二	35	進化生物学研	112 東京都文京区小日向 1-9-4	(電03-945-6770)	脊椎動物
半沢正四郎	35		982 仙台市遠見塚 2-34-16	(電0222-86-2926)	有孔虫
藤本　治義	35		165 東京都中野区江原町 1-32-8	(電03-951-1925)	生層位，有孔虫，サンゴ
槇山　次郎	35		606 京都市左京区田中春菜町 22	(電075-781-3324)	貝類，層序

会員

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氏名	入会年	所属機関名	連絡先		専門研究分野
相田　吉昭	79	東北大理地質古生物	982 仙台市八木山本町 1-1-6, 興栄マンション401号	(電0222-28-0148)	放散虫，層序
相場　博明	80		184 東京都小金井市梶野町 3-4-6, 三苫方		植物
青木　直昭	58	筑波大地球科学	174 東京都板橋区前野町 6-24-5-607		有孔虫，層序
青島　睦治	72	栃木県博	320 宇都宮市鶴田町 1892, むつみ荘		有孔虫，古生態
青山　尚友	71	高千穂高	882-11 宮崎県西臼杵郡高千穂町 三田井 6294の3	(電09827-2-3717) 教職員アパート 301	堆積
赤井こず江	77	城山小	350-02 埼玉県坂戸市中富町 8-2	(電0492-83-6598)	大型有孔虫
赤木　三郎	54	鳥取大教育地学	680 鳥取市湖山町南5-639 (電0857-28-0578)		第四紀地質

赤松	守雄	78	北海道開拓記念館	061-01	札幌市白石区厚別町小野幌，同左		古生態
秋葉	文雄	69	石油資源開発(株)技研	188	東京都田無市芝久保町2-13-234	(電0424-69-1064)	珪藻，生層序
秋元	和美	77		165	東京都中野区江原町 1-10-8	(電03-951-6620)	有孔虫，層序
*阿久津	純	48	宇都宮大教養地学	329-27	栃木県須那郡西那須野町朝日町 8-1	(電02873-6-0644)	珪藻，層序
浅賀	正義	74	千葉県教育センター	281	千葉県花見川 7-14-502	(電0472-58-9956)	軟体動物，層序
*浅間	一男	40	国立科博地学	191	東京都日野市百草 923-7	(電0425-92-3455)	植物，系統・進化
浅見	清秀	68	八潮高	230	横浜市鶴見区東寺 3-1-17		
安達	修子	77	筑波大地球科学	300-31	茨城県新治郡桜村妻木 1239川中方	(電0298-51-2666呼)	有孔虫，貝形類
阿部	勝巳	77	東大理地質	272-01	千葉県市川市相之川 2-1-9ハイツ泉沢11号	(電0473-57-4495)	貝形虫
天野	和孝	77	筑波大地球科学	300-31	茨城県新治郡桜村字天久保，同左		軟体動物
*天野	昌久	51		862	熊本市保田窪本町出山 739	(電0963-66-5948)	軟体動物，層序
*新井	重三	52	埼玉大教育地学	338	埼玉県与野市大戸 2-2-13	(電0488-32-3308)	堆積
荒川	真二	80	千葉大理地学	340	埼玉県草加市瀬崎町 1385-23		コケ虫
荒木	英夫	76	気仙沼市図書館	988	宮城県気仙沼市太田 2-6-105	(電0226-23-2721)	頭足類，三葉虫
荒木	慶雄	50		514	三重県津市八町 2-6-22	(電0592-28-0625)	軟体動物，層序
有川	隆一	73	東北大理地質古生物	980	仙台市荒巻字青葉，同左		有孔虫
安藤	寿男	78	東大理地質	171	東京都豊島区要町 1-33さつき荘	(電03-957-3026)	二枚貝，層序
安藤	保二	63		673	兵庫県明石市太寺 4-15-9	(電078-918-1716)	軟体動物

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井口	休夫	78	北海道教育大旭川分校	070	旭川市末広東 2-3	(電0166-52-3410)	花粉
生路	幸夫	74	石油資源開発(株)	064	札幌市中央区南13条西 23-4石油開発(株)伏見ＡＰ1-7	(電011-551-2055)	有孔虫，層序
池田	正	74		583	大阪府羽曳野市島泉 1-24-10ロイヤルハイツオクノ 202		有孔虫
池原	研	79	東京学芸大地学	184	東京都小金井市本町 4-20-39寿荘	(電0423-85-1889)	植物
*池辺	展生	35	帝塚山大教養	659	兵庫県芦屋市浜町 6-4	(電0797-22-5716)	生層序
*池谷	仙之	62	静岡大理地球科学	422	静岡市大谷 836，同左	(電0542-37-1111)	有孔虫，貝形虫
*猪郷	久治	70	東京学芸大地学	181	東京都三鷹市牟礼 6-23-541	(電0422-43-1986)	コノドント，層序
*猪郷	久義	54	筑波大地球科学	305	茨城県新治郡桜村並木4-931-104	(電0298-53-4320，4549)	紡錘虫，サンゴ，コノドント
*石井	醇	58	東京学芸大地学	158	東京都世田谷区尾山台2-14-20	(電03-702-0577)	紡錘虫，層序

*石井　健一	48	姫路工大	565	大阪府吹田市青山台 4-12-10	(電06-834-0205)	紡錘虫，生層位
石川　正	67	文命中	251-01	神奈川県南足柄市塚原 706		
石川　亨	78	日特建設	814	福岡県福岡市西区大字橋本 217-2，住宅公団三室団地 6-303	(電092-862-5463)	層序
石黒　義人	76	日本アイ・ビー・エム(株)	420	静岡市田町 5-44-15，白鷺マンション 101 号	(電0542-53-6636)	
*石崎　国熙	60	東北大理 地質古生物	980	仙台市米ヶ袋 2-3-17	(電0222-27-1403)	貝形類
石田　啓裕	79	徳島大教養地学	770	徳島市佐古四番町 7-15 米本荘 101	(電0886-23-5125 呼)	コノドント，層序
*石田　志朗	58	京大理地鉱	606	京都市左京区岩倉三宅町 250-5	(電075-711-3532)	植物，層序
石田　正夫	58	地調北海道支所	060	札幌市南1条西18丁目，同左		層序
*石橋　毅	67	九大理地質	811-31	福岡県粕屋郡古賀町久保 古賀公務員住宅 7-32	(電09294-4-1448)	アンモナイト
*石和田靖章	51	石油公団 技術センター	156	東京都世田谷区松原 3-5-9	(電03-321-1698)	有孔虫，石油地質
磯崎　行雄	80	大阪市大理地学	520	滋賀県大津市長等 2-1-16	(電0775-22-7080)	コノドント，層序
礒田　喜義	72	農大二高	370	郡馬県高崎市元島名町 523	(電0273-52-8188)	古植物
礒見　博	51	地調	153	東京都目黒区駒場 1-26-26	(電03-467-4994)	有孔虫，層位
板垣　久治	80		072	北海道美唄市進徳町1区		アンモナイト
*市川浩一郎	48	大阪市大理地学	593	堺市堀上緑町 2-10-9	(電0722-77-5253)	二枚貝，放散虫，層序
*市川　渡	35		920	金沢市石引 2-28-12	(電0762-61-5221)	珪藻，珪質鞭毛藻
市倉　賢樹	73	上白根中	241	横浜市旭区東希望ヶ丘 39 岡田方	(電045-391-0728)	有孔虫，層序
一ノ関鉄郎	80	石油資源開発(株)技研	190-11	東京都西多摩郡羽村町緑ヶ丘 3-5-5，同左		有孔虫
伊藤　隆夫	80	室蘭市港北中	050	室蘭市高砂町 2-15-12	(電0143-46-1971)	
伊藤　真	72	川越高	359	埼玉県所沢市所沢 524-2-604	(電0429-95-6411)	層位
*糸魚川淳二	53	名大理地球科学	468	名古屋市天白区平針，川田原住宅 1-1006	(電052-803-0804)	軟体動物，古生態
伊奈　治行	75	名大理地球科学	479	愛知県常滑市市場町 6-89		植物
稲葉　良一	80	昭和学院小中	272	市川市宮久保 1-14-7 泉ハイツ	(電0473-73-9566)	層序
井上　英二	72	地調海洋地質	218	千葉市園生町 1113-4 ドルミ稲毛 607	(電0472-53-4843)	海洋地質，層序
井上　武	39		010	秋田市手形中台 59-14		層位
井上　雅夫	74	岩手大教育 理科教育	020	盛岡市上田 3-15-11	(電0196-23-7758)	堆積
井上　洋子	76	石油資源開発(株)技研	168	東京都杉並区浜田山 4-6-6	(電03-311-0984)	有孔虫，生層序
猪間　明俊	61	石油資源開発(株)	180	東京都武蔵野市吉祥寺北町 4-6-6	(電0422-54-1896)	石油地質
茨木　雅子	72	静岡大理 地球科学	421-01	静岡市丸子新田 390	(電0542-59-0967)	有孔虫，層序

*今西　茂	48	熊大教養地学	862	熊本市湖東 3-13-20	(電0963-68-2098)	層序
*今村　外治	35		733	広島市西区高須 4-163-10	(電0822-71-1930)	層序
今村　忠彦	55	高知北高	781-02	高知市瀬戸西町 3-138	(電0888-42-5420)	
岩井　淳一	36	東北ボーリング鑿泉	980	仙台市北鷺ヶ森 5-68	(電0222-34-8032)	層位
*岩井　武彦	46	弘前大教育地学	036	弘前市森町 13	(電0172-34-3962)	軟体動物，層序
岩尾雄四郎	76	佐賀大理工土木	840	佐賀市本庄町西川内 373-8	(電0952-26-7436)	植物，層序
*岩崎　泰頴	61	熊本大理地学	862	熊本市神水本町 13-57	(電0963-83-2203)	二枚貝，巻貝

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植田　房雄	35		228	神奈川県座間市広野台 1-5113-1	(電0462-51-3713)	堆積，層序
植田　芳郎	54	地調北海道支所	064	札幌市中央区宮の森３条10丁目，宮の森住宅 402-42 号	(電011-631-0838)	層序
*上野　輝彌	66	国立科博地学	181	東京都三鷹市深大寺 3967	(電0422-31-0712)	魚類
植松　芳平	75	山添高	997	山形県鶴岡市新形町 20-5		植物
植村　和彦	70	国立科博地学	281	千葉市稲毛海岸 5-5-30-408	(電0472-46-0530)	植物
*魚住　悟	51	北大理地鉱	064	札幌市中央区南13条西22丁目	(電011-561-3924)	軟体動物，生鉱物
*氏家　宏	53	琉球大理海洋	903	那覇市首里崎山町 4-67-11	(電0988-85-4162)	有孔虫，層序
歌代　勤	48	新潟大教育地学	943	上越市西城町 1-9-22	(電0252-23-4354)	生痕，層序
内田　信夫	51	成蹊高	189	東京都東大和市湖畔 2-1044-144	(電0423-24-6282)	古期火山岩
打矢　貞子	64	男鹿高	010	秋田市八橋字八橋 30-12	(電0188-63-7069)	有孔虫
浦田　英夫	48	九大教養地学	814	福岡市西区原 1-35-2	(電092-821-9432)	層序

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江藤　哲人	69	横浜国大教育地学	236	横浜市金沢区並木 1-3-4-603	(電045-773-0309)	層序，構造地質
衛藤　俊治	48	岐阜教育大学地学研究室	501-31	岐阜市芥見 6305-125	(電0582-42-2372)	地史，構造地質

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*大炊御門経輝	35		171	東京都豊島区長崎 1-25-15	(電03-957-4119)	
大石　朗	79	新日本技術コンサルタント(株)	573	大阪府枚方市西禁野 2-13-10 同左，枚方寮	(電0720-47-3800)	微化石層序
大石　徹	77		336	埼玉県浦和市常盤 3-11-18	(電0488-33-5660)	植物
大上　和良	69	岩手大工資源	020	盛岡市上田 4-3-5	(電0196-63-1664)	堆積
大木　公彦	71	鹿児島大理地学	890	鹿児島市明和 4-14-9-51	(電0922-82-0739)	有孔虫，層序
大久保　敦	79	東京学芸大地学	187	東京都小平市喜平町 860-1 小平団地 1-3-208	(電0423-21-9130)	植物
大崎　康吉	78	九大歯学部	811-33	福岡県宗像郡津屋崎町天神 778	(電09405-2-0007)	
大路　樹生	80	東大理地質	158	東京都世田谷区等々力 1-19-10	(電03-704-3935)	

*太田	正道	63	北九州市自然市博	806	北九州市八幡西区上上津役団地 2-3	(電093-612-4867)	紡錘虫，サンゴ
*太田	喜久	57	福岡教育大地学	824-08	福岡県京都郡勝山町上久保 1914		中生代非海棲二枚貝
*大塚	裕之	64	鹿児島大理地学	890	鹿児島市郡元 1-21-35，同左		哺乳類
大塚	雅勇	76	川尻小	861-11	熊本県菊池郡合志町豊岡2527-94	(電09624-8-4500)	二枚貝，生痕，層序
大塚	康雄	80	愛媛大理地球科学	790	松山市文京町 2-5，同左		
大塚	泰代	77	筑波大地球科学	270	千葉県松戸市五香新田13-260	(電0473-84-7037)	
大野	照文	75	京大理地鉱	606	京都市左京区北白川追分町，同左		古生態
*大場	忠道	66	東大海洋研無機化学	350-02	埼玉県入間郡鶴ヶ島町上広谷 406-7	(電0492-86-0241)	同位体地質学
大花	民子	77	東京学芸大地学	101	東京都千代田区神田 3-6-10	(電03-261-1966)	植物
*大原	隆	63	千葉大教養地学	281	千葉市稲毛町 5-122	(電0472-42-7008)	軟体動物
*大村	明雄	66	金沢大理地学	921	金沢市弥生 1-20-25	(電0762-43-8026)	同位体古生物学
大村	一夫	65	ダイヤコンサルタント(株)	270-11	千葉県我孫子市若松 151-3	(電0471-84-3090)	層位，応用地質
*大森	昌衛	48	麻布獣医大教養自然科学	177	東京都練馬区石神井台 3-32-5	(電03-996-2341)	軟体動物
*大山	桂	36	鳥羽水族館	517	三重県鳥羽市鳥羽3-3-6，同左	*(電05992-5-2555)	軟体動物
*大山	年次	37		300-15	茨城県北相馬郡藤代町谷中208		植物
岡崎	由夫	62	北海道教育大釧路分校	085	釧路市住江町 11-24	(電0154-23-5884)	花粉
岡崎	美彦	75	北九州市自然市博	802	北九州市小倉南区北方2-16-5-203	(電093-92-4572)	脊椎動物
小笠原憲四郎		72	東北大理地質古生物	982	仙台市八木山本町 2-23-6	(電0222-29-6382)	貝類，層序
岡田	清史	78	早大理工資源	189	東京都東村山市本町 4-16，70-8	(電0423-94-7738)	石灰岩
*岡田	博有	58	静岡大理地球科学	420	静岡市安東 3-18-25-105	(電0542-47-4121)	海洋地質
岡田	尚武	77	山形大理地球科学	990-23	山形市蔵王飯田字水上 168-9	(電0236-22-8383)	ナンノプランクトン，層序
岡田	豊	74	東大理地質	113	東京都文京区本郷，同左		貝形類
岡村長之助		74	岡村化石研究所	450	名古屋市港区甚兵衛通 5-12，同左	(電052-381-2578)	脊椎動物，その他
岡村	真	72	高知大理地質	780	高知市曙町 2-5-1，同左		微化石層位
*岡本	和夫	54	広島大学校教育地学	735	広島市東区安芸町温品 353-17	(電0822-89-2873)	貝類，層序
岡本	隆	80		108	東京都港区高輪 2-9-18	(電03-447-5605)	
小川賢之輔		52		417	静岡県富士市中里町 3-164-4	(電0545-34-1007)	軟体動物，層序
小川	久	62	瑞穂建材工業(株)生産部	198	東京都青梅市成木 8-877，同左	*(電0428-7-4211)	
荻野	繁治	68	関東学院中高	233	横浜市野庭町 673H6-505	(電045-843-6468)	
*沖村	雄二	60	広島大理地鉱	730	広島市東区戸坂桜上町13-21-4	(電0822-29-0853)	有孔虫，層序

奥田	尚	71	刑部小	581	大阪府八尾市八尾木北 6-126	(電0729-94-5341)	三畳紀サンゴ
奥村	清	76	神奈川県教育センター	259-01	神奈川県中郡二宮町山西 1026	(電0463-71-1350)	軟体動物，層序
奥村	好次	75	瑞浪化石博	509-61	岐阜県瑞浪市明世町月吉 587	(電0572-68-7603)	
*奥津	春生	40		983	仙台市小松島新堤 14-1	(電0222-34-3002)	第三紀植物，層序
*小倉	謙	33		171	東京都豊島区西池袋 5-20-12	(電03-971-1040)	
大越	章	74	藤沢小	369-18	埼玉県秩父郡荒川村上田野 504-8	(電04945-4-1263)	第四紀地質
生越	忠	48	和光大人文	194	東京都町田市鶴川 2-11-3-13	(電0427-35-6065)	軟体動物
*尾崎	公彦	67	横浜国大教育地学	240	横浜市保土ヶ谷区今井町 286-1	(電045-353-2451)	新生代植物
*尾崎	博	35	斎藤報恩会自然史博	167	東京都杉並区天沼 2-5-29	(電03-398-3984)	層位
長田	敏明	74		140	東京都品川区勝島 1-7, 4-301	(電03-764-6231)	内湾の貝類
*小沢	智生	66	東大理地質	186	東京都国立市中 3-3-15	(電0425-75-3658)	紡錘虫，腹足類，進化
*押手	敬	55	北海道教育大函館分校	040	函館市八幡町 1-2，同左		珪藻，層序
尾田	太良	71	東北大理地質古生物	980	仙台市本町通 2 丁目 2-40	(電0222-74-2052)	有孔虫，層序
小田	博	79	北海道斜里町役場	099-41	北海道斜里郡斜里町本町 5 番地		
*小貫	義男	36	長谷地質調査(株)	980	仙台市国見 2-15-5	(電0222-34-5558)	生層序
小野	慶一	77	国立科博地学	356	埼玉県川越市大字木野目 321-5	(電0492-35-4013)	脊椎動物
*尾上	亨	56	地調地質	305	茨城県新治郡桜村吾妻 4-203-102	(電0298-51-6875)	新生代植物
小野寺信吾		57	杜陵高水沢分校	021	岩手県一関市桜木町 3-30	(電01912-3-6556)	哺乳動物
*小畠	郁生	56	国立科博地学	193	東京都八王子市めじろ台 4-18-8	(電0426-63-0884)	アンモナイト，生層序

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海保	邦夫	77	東北大理地質古生物	980	仙台市八木山弥生町 5-32庄司方	(電0222-29-0032)	有孔虫
香川	良道	80	北海道留萌高	077	北海道留萌市千鳥町 3-1	(電01644-2-3747)	地史
笠原	芳雄	77	岐阜県博	501-31	岐阜市大洞桐ヶ丘 1-4-22	(電0582-43-8214)	火山層序
風間	敏	80	筑波大地球科学	305	茨城県新治郡桜村花室 989-3	(電0298-57-5857)	コノドント
*鹿島	愛彦	64	愛媛大教養地学	790	松山市東長戸 4-3-1愛媛大学宿舎 513 号	(電0899-25-3883)	層序
加瀬	友喜	76	国立科博地学	272-01	千葉県市川市大洲 2-2-21	(電0473-25-2748)	腹足類，分類
*甲藤	次郎	60	高知大理地質	780	高知市升形 8-40		プロブレマチカ，分類
嘉藤良次郎		48	名大教養地学	465	名古屋市名東区平和ガ丘 3-13平和ガ丘住宅 1-603	(電052-781-9107)	層序
加藤	穣司	64	川鉄物産(株)	177	東京都練馬区東大泉町 314-11	(電03-925-0357)	バクテリア

加藤　進	73		452	名古屋市西区平中町 180		
加藤　法彦	79	早大教育地学	214	川崎市多摩区生田 5003-7		生層序
*加藤　誠	54	北大理地鉱	064	札幌市中央区宮の森 1-18-1235-286	(電011-644-1426)	古生代腔腸動物，層序
加藤又二郎	58	防災地質工業	022	札幌市北区篠路町拓北 76-47	(電011-771-8560)	
加藤　道雄	70	広島大総合科学	733	広島市中区吉島東 2-17-6-306	(電0822-49-7184)	有孔虫，層序
門田　真人	79	東海大相模高	243-02	神奈川県厚木市三田 458-6	(電0462-41-2103)	サンゴ，有孔虫
金森　邦夫	71	石油公団技術部	335	埼玉県蕨市中央 1-11-12 リークハイツ 905号		有孔虫
*蟹江　康光	61	横須賀市博	239	横須賀市馬堀海岸1-1-4，B103	(電0468-43-0746)	白亜紀軟体動物
*鹿沼茂三郎	50	新教育者連盟	181	三鷹市上連雀 6-11-13	(電0422-44-2745)	紡錘虫，層序
金子寿衛男	53		591	大阪府堺市新金岡町3-1-16-101		軟体動物
金杉　洋美	72	筑波大地球科学	305	茨城県筑波郡谷田部町春日 1-11-203-1206		微化石
*金谷　太郎	48	金谷ホテル(株)	166	東京都杉並区阿佐ヶ谷北 5-4-17	(電03-337-3715)	珪藻，層序
鎌田耕太郎	80	北大理地鉱	060	札幌市北区北10条 西８丁目，同左		層位，堆積
鎌田　浩志	57	南スマトラ石油開発(株)	235	横浜市磯子区洋光台2-1-2-202	(電045-833-7651)	石油地質
*鎌田　泰彦	48	長崎大教育地学	852	長崎市昭和町 452-277	(電0958-45-0255)	軟体動物，堆積
*亀井　節夫	55	京大理地鉱	606	京都市左京区松ヶ崎 今海道町 18	(電075-711-6422)	哺乳動物
亀山　徳彦	67	北九州大文	811-32	福岡市宗像郡福間町小竹 188-36	(電09404-3-3215)	新生代底生有孔虫
河合　正虎	50	川崎地質(株)	701-03	岡山県都窪郡早島町大字 前潟 1025	(電0864-82-0013)	層序，地質構造
川上　享	72	三菱石油開発(株)	213	川崎市高津区土橋 7-22-14	(電044-855-8353)	石油地質
川上　広	74		517-05	三重県志摩郡阿児町神明	(電05994-3-2309)	層位
川口　健一	78	ジャパン石油	153	東京都目黒区上目黒 5-18-19 コーポ，ヒガシヤマ 505		有孔虫，層序
川沢　啓三	66	追手前高	780	高知市井口町 129	(電0888-72-0012)	有孔虫，層序
川下由太郎	80	北炭幌内炭鉱(株)	068-22	北海道三笠市唐松千代田 2-A1-5	(電01267-2-6091)	
河田　茂磨	48		336	埼玉県浦和市前地 2-3-5	(電0488-82-1888)	有孔虫，層位
*河野　通弘	54		753	山口市宝町 3-54	(電0839-22-4789)	紡錘虫，層序
川端　潤	80	明治大農	158	東京都世田谷区奥沢 7-15-11		
川辺　鉄哉	66	千葉大理地学	281	千葉市小中台町 877 千葉大学北宿舎 1B-1	(電0472-54-0351)	三角貝，層序
河村　善也	78	愛知教育大地学	448	愛知県刈谷市井ヶ谷町広沢 公務員宿舎 1-104	(電0566-36-4769)	脊椎動物
間舎　美幸	74		135	東京都江東区富岡 1-13-5		植物
神田　要	74		356	埼玉県上福岡市福岡 1607-264		
*菅野　三郎	53	上越教育大地学	943	新潟県上越市西城町 1-7-2，同左	(電0255-25-8383)	軟体動物，層序

*神戸　信和	46	地調地質	164	東京都中野区中央 2-49-11	(電03-361-2588)	
*勘米良亀齢	48	九大理地質	183	福岡市東区香椎ヶ丘 528	(電092-662-1691)	紡錘虫，層序

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菊池　良樹	54	北スマトラ石油(株)	186	東京都国立市西 3-2-2		石油地質
菊池　芳文	78	筑波大地球科学	305	茨城県新治郡桜村吾妻 1-403-402	(電0298-51-2056)	古生態
北里　洋	71	静岡大理 地球科学	422	静岡市大谷 836, 静岡大宿舎 425 号	(電0542-37-2311)	有孔虫，古生態
北村　健治	66	明星学苑	198	青梅市末広町 2-5-20	(電0428-31-2232)	三角貝，層位
木下　勤	71	資源コンサルタント	181	東京都三鷹市井の頭 5-20-7	(電0422-43-1764)	コノドント，層序
*木村　達明	51	東京学芸大地学	177	東京都練馬区南大泉 40	(電03-924-3859)	植物
*木村　敏雄	41	東大理地質	222	横浜市港北区仲手原 2-25-32	(電045-401-5927)	構造地質，層序

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久家　直之	80	京大理地鉱	606	京都市左京区一乗寺稲荷町 22 西村方	(電075-701-1441)	脊椎動物
久次米　旭	71	応用地調(株) 大阪事務所	564	大阪府吹田市垂水町 2-36-27		アンモナイト，層位
*楠見　久	50	鈴峯女子短大	733	広島市西区己斐上 4-286-200	(電0822-72-0255)	層序，エステリア
久保　親弘	78	東北歯科大	963	福島県郡山市富田町字不動前 28, ミカドビル 403	(電0249-38-0141)	
*栗原　謙二	66	立教大学一般教育	171	東京都豊島区西池袋 2-25-10-503	(電03-988-5071)	有孔虫
栗原　豊	80	東京学芸大地学	170	東京都豊島区駒込 6-33-13	(電03-917-2938)	植物
黒沢　利衛	74	科学飼料研究所(株)	370-12	高崎市宮原町 8	(電0273-46-8783)	薬学
黒田登美雄	80	九大理地質	812	福岡市東区箱崎6-10-1，同左		花粉，堆積
*桑野　幸夫	51	国立科博地学	222	横浜市港北区日吉本町 1797	(電044-61-4296)	コノドント，有孔虫

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*小池　敏夫	62	横浜国大教育地学	240	横浜市保土ヶ谷区常盤台 156，同左		コノドント
小池　裕子	75	東大総合研究資料館	177	東京都練馬区石神井台 3-12-6	(電03-996-6028)	貝類
*小泉　格	64	大阪大教養地学	560	大阪府待兼山町 1-1，同左		珪藻，層序
小泉　斉	65		281	千葉県稲毛海岸 3-3-8-301	(電0472-43-5226)	三葉虫，腕足類
香西　武	80	~~大阪~~小	782	高知県香美郡土佐山田町 ~~1682~~ 891-8 県住: ~~2-15~~ 西本町 山田小学校		二枚貝
*小高　民夫	48	東北大理 地質古生物	982	仙台市桜木町 18-18	(電0222-29-0673)	軟体動物，生層序
古藤　次郎	53		171	東京都豊島区南長崎 4-20-10	(電03-950-0930)	腕足貝，有孔虫

後藤　仁敏	67	鶴見大歯解剖	244	横浜市戸塚区飯島町 2335-7	(電045-894-1052)	脊椎動物，歯
後藤　博弥	65	神戸大教養地学	679-41	兵庫県竜野市竜野町四箇 307	(電07916-2-0990)	紡錘虫，層位
*粉川　昭平	60	大阪市大理生物	630	奈良市六条緑町 2-1537-177	(電0742-46-3314)	植物
後閑　雅文	77		336	浦和市岸町 3-2-2	(電0488-22-1193)	
*小西　健二	48	金沢大理地学	920	金沢市涌波 2-7-10	(電0762-21-5354)	造礁生物
*小林　巌雄	58	新潟大理地鉱	951	新潟市関屋本村町 1-150 合同宿舎ＲＢ102	(電0252-65-0848)	軟体動物，化石の微細構造
小林　学	54	筑波大学校教育	177	東京都練馬区西大泉町 2051-1	(電03-924-1807)	有孔虫，層序
小林　博明	80	千葉大理地学	284	千葉県印旛郡四街道町栗山 242-35	(電0434-21-0251)	珪質鞭毛藻
小林　文夫	71		189	東京都東村山市栄町 1-24-3-203	(電0423-95-6841)	紡錘虫，層序
*小畠　信夫	35	親和女子大	663	兵庫県西宮市甲子園二番町2-6	(電0798-41-3026)	植物
小村　精一	74	石油資源開発(株)技研	350-13	埼玉県狭山市青柳 63 新狭山ハイツ 13-303	(電0429-54-5576)	珪藻，層序
米谷　秀雄	77	北浦三育中	311-17	茨城県行方郡北浦村成田 895，同左	*(電02915-3142)	層序
紺田　功	71	奈良高	630	奈良県大和郡山市南郡山 458	(電07435-3-8324)	有孔虫，層序

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斉藤　隆	68	石油公団	100	千葉県野田市岩名 1-42-6	(電0471-29-5388)	
*斎藤　常正	78	山形大理地球科学	990	山形市あかねが丘 3-1-5	(電0236-45-2931)	有孔虫，層序
*斎藤登志雄	48	茨城大理地球科学	310	茨城県水戸市文京 1-10-7	(電0292-25-0296)	堆積
斎藤　実	70	香川大農	761-01	高松市屋島西町 2076-1，公務員住宅 5-206	(電0878-41-3518)	層序
斎藤　林次		エス・ジー技研(株)	860	熊本市黒髪 4-2-47	(電0963-42-6078)	層序
*斎藤　靖二	64	国立科博地学	131	東京都墨田区東向島 3-25-3	(電03-614-6832)	堆積岩
斎藤　豊	71	信州大教育地学	380	長野市吉田 2-12-19	(電0262-41-5040)	層序
*酒井豊三郎	70	宇都宮大教養地学	321	宇都宮市下平出町 950-13 宇大工学部ＲＣ宿舎 2-10	(電0286-62-8027)	放散虫，層序
*坂上　澄夫	54	千葉大理地学	281	千葉市小中台町 877 千葉大北宿舎 1-A-9	(電0472-56-5734)	こけむし，紡錘虫
*坂口　重雄	39		565	大阪府豊中市新千里東町 2-5，A1-201	(電06-872-3107)	紡錘虫，層序
坂本　省吾	79	復建調査設計(株)	735	広島市東区安芸町大字馬木 1455-2　大原荘	(電0822-62-5151呼)	層序，応用地質
桜井　欽一	35	自営	101	東京都千代田区神田須田町 1-15	(電03-251-0577，0620)	貝
笹川　清一	68	石油公団	100	東京都千代田区内幸町 2-1-4 日比谷中日ビル 同左 技術部		生層位，有孔虫
佐々木　衛	76	星野女子高	349-02	埼玉県南埼玉郡白岡町高岩 1786-8	(電04809-2-6229)	
指田　勝男	77	筑波大地球科学	196	東京都昭島市上川原町 167	(電0425-44-8823)	紡錘虫，小型有孔虫

*佐田　公好	60	広島大総合科学	734	広島市翠町 1132 グリーンシャトー 203 号	(電0822-55-8351)	紡錘虫，サンゴ類
佐藤　二郎	64	岩手県教育委員会	023	岩手県水沢市表小路 1-78		古魚類
*佐藤　誠司	61	北大理地鉱	062	札幌市豊中区平岸木の花団地 6-206		花粉，生層位
*佐藤　正	53	筑波大地球科学	300-31	茨城県新治郡桜村竹園 3-702-201	(電0298-57-3563)	中生代頭足類，構造地質
佐藤　特幸	79	帝国石油技研	151	東京都渋谷区幡ヶ谷 1-31-7-804	(電03-465-8901)	有孔虫，石灰質ナンノ化石
佐藤　勉	80	北星コンサルタント(株)	01235	夕張市南部岳見町	(電01235-5-3220)	層序
佐藤　昌人	79	苫小牧市青少年センター	053	苫小牧市松風町 2 番 4 号104	(電0144-74-3376)	珪藻
佐藤　喜男	77	九大理地質	812	福岡市東区箱崎 6-10-1，同左		軟体動物
佐藤　芳雄	80	札幌西高	063	札幌市西区手稲宮の沢 22-4	(電011-662-2492)	白亜紀，層序
佐藤　良嗣	80	筑波大地球科学	305	茨城県新治郡桜村上境 滝ノ山 332-8	(電0298-57-4286呼)	層序，微化石
佐俣　哲郎	74	麻布獣医科大教養自然科学	248	神奈川県鎌倉市稲村千崎 5-10-21	(電0467-31-8989)	生化学
沢田　義男	50	室蘭工大開発	050	室蘭市水元町 40-40	(電0143-44-6487)	層序
沢村孝之助	64	地調	214	川崎市多摩区生田 8708		珪藻

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志井田　功	56	桜井女子短大	630-21	奈良市矢田原町乙 151-2	(電0742-81-0531)	層序
塩原　鉄郎	55	弘前大教育地学	036	弘前市文京町 1，同左		有孔虫
実崎　悟郎	69	碩信高	870-03	大分市屋山 426	(電09759-2-0684)	生層位，紡錘虫
柴田　晃	69	高梁高	718	岡山県新見市高尾 717-2	(電08677-2-2885)	
柴田　豊吉	46	秋田大鉱山地質	010	秋田市手形学園町 1-1，同左		層序
柴田　博	64	名大教養地学	470-11	愛知県豊明市栄町殿山 28-32	(電0566-97-3498)	貝類，層序
島倉己三郎	36		630	奈良市紀寺新屋敷町 381-5		
嶋崎　統五	73	石油資源開発(株)技研	335	埼玉県蕨市北町 2-7-14	(電0484-32-4504)	花粉
*清水大吉郎	54	京大理地鉱	606	京都市左京区田中 西樋ノ口町 48	(電075-701-4652)	腕足類，地史
清水　照夫	70	日本地科学社	604	京都市中京区麩屋町通 御池上る	(電075-222-1417)	地質
下中　昌樹	75	美方高	919-13	福井県小浜市今宮 34	(電07705-2-0233)	珪質鞭毛藻，層序
下野　洋	79	岐阜県教育センター第三研修部地学研究室	500	岐阜市芥見野畑 2-55	(電0582-43-1805)	花粉，古環境
下山　正一	74	九大理地質	812	福岡市東区箱崎 3-8-11 多田鉄二方	(電092-641-5753)	生態
白井　健裕	58	新潟大教育地学	951	新潟市旭町通 2 番町746，同左		新生界層位，有孔虫

白石	成美	70	上対馬高	817-17	長崎県上県郡上対馬町 比田勝 309	(電09208-6-3998)	生痕
白神	孝	69	全日本コンサルタント(株)	581	大阪府八尾市美園町 1-17-9	(電0729-96-2488)	応用地質
白木	孝佳	78		177	東京都豊島区池袋本町 1-8-6 堀田方		アンモナイト
守随	治雄	78	応用地質調査(株)岡山事務所	702	岡山市福富東 2-15-28 山本方	(電0862-63-6321呼)	
*首藤	次男	50	九大理地質	815	福岡市南区長丘 2-21-35	(電092-511-7388)	軟体動物，層序
新保	久弥	51	石油資源開発(株)	270	千葉県松戸市五香六実 7-324	(電0473-85-7090)	有孔虫
神保	悳	36		990	山形市飯塚町 62	(電0236-43-9040)	層位
神保	幸則	67	本州製紙(株)	158	東京都世田谷区瀬田 4-17-7	(電03-700-4773)	軟体動物，層序

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菅野	耕三	69	大阪教育大地学	581	大阪府八尾市八尾木東 2-32 八尾合同宿舎 814 号	(電0729-92-1893)	放散虫，層序
菅谷	政司	74	結城第二高	311-11	茨城県東茨城郡常澄村東前 1235	(電029269-2552)	有孔虫，層序
杉田	福松	75	大阪教育大学	561	大阪府豊中市曾根東町 1-11-46-221		腔腸動物，中生代層孔虫
杉田	宗満	61	岡山大理地学	700	岡山市津島中 1-3 ＲＡ202	(電0862-53-1888)	層序，構造
*杉村	昭弘	68	秋吉台科博	754-05	山口県美祢郡秋芳町秋吉片山	(電08376-2-0661)	古生代こけ虫類の分類
杉本	幹博	66	金沢大教育地学	920	金沢市天神町 1-5-67		層位
杉山	卓	79		214	川崎市多摩区生田 5031-5	(電044-933-5235)	化石層序
杉山	哲男	77	福岡大理地学	814	福岡市西区室住団地 45-103	(電092-841-0791)	古生代サンゴ
鈴木	陽雄	42		329-21	栃木県矢板市川崎反町 241	(電02874-3-0766)	層序
*鈴木	敬治	48	福島大教育地学	960	福島市渡利転石 16-3	(電0245-23-5577)	植物
鈴木	茂	80	熊本大理地学	860	熊本市黒髪 6-11-61 安田方	(電0963-43-2789)	新生代植物
鈴木	茂之	79		171	東京都豊島区池袋 2-1065		構造地質
鈴木	孝善	78		078-02	旭川市永山９条９丁目 115-82	(電0166-48-4830)	層序，軟体動物
*鈴木	順雄	61	北海道教育大釧路分校地学	085	釧路市鶴ヶ岱 3-6-25	(電0154-42-3264)	植物
鈴木	三男	73	東大農森林植物	270-11	千葉県我孫子市布佐1400-134	(電0471-89-0169)	材化石
鈴木	康司	48	山形大教育理科	990	山形市七日町 4-13-9	(電0236-32-6561)	軟体動物，層序
鈴木	保宏	78	小手指中	352	埼玉県新座市片山 3-17-4	(電0484-79-7370)	層序
角	靖夫	58	地調地質	305	茨城県筑波郡谷田部町 松代 1-113-1	(電0298-51-8755)	層序
*須鎗	和巳	48	徳島大教養地学	770	徳島市八万町大坪 232-1 公務員宿舎 3-11 号	(電0886-68-2242)	放散虫，構造地質

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*関戸	信次	62	小松高	923	石川県小松市本大工町 1-23	(電0761-21-0644)	植物
瀬名波	任	77	那覇高	900	沖縄県那覇市久茂地 3-25-7	(電0988-62-2709)	有孔虫

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曾我部正敏	51	地調燃料	305	茨城県新治郡桜村吾妻 3-940-1	(電0298-51-9699)	層序
傍島　竹史	76	東農高	503	岐阜県大垣市北切石町 2-52 板良住宅43号	(電0584-81-7119)	コノドント

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*多井　義郎	50	広島大総合地学	734	広島区南区元宇品町 27-10	(電0822-54-7582)	有孔虫，層序
平　朝彦	80	高知大理地学	780	高知市曙町 2-5-1，同左		堆積環境，生痕
*平　一弘	67	北海道教育大 旭川分校地学	078-11	旭川市豊岡町 9-4-106	(電0166-33-8391)	同位体地質 二枚貝，層序
高岡　善成	51	桐朋学園大	187	東京都小平市上水本町 1515	(電0423-21-4867)	紡錘虫
高崎　郷二	80		198-01	東京都西多摩郡奥多摩町 小丹波 516	(電04288-5-1190)	層位
*高橋英太郎	35		753	山口市宮野下，上恋路 1190-5	(電0839-22-4779)	植物，層序
*高橋　清	54	長崎大教養地学	859-06	長崎県西彼杵郡長与町 吉無田郷 48-1	(電09588-3-2612)	パリノロジー，層序
高橋　武美	80	寒住プレハブ工業	068-22	北海道三笠市弥生花園町 28番地 109	(電01267-6-7042)	白亜紀アンモナイト
*高橋　治之	60	茨城大理地球科学	310	水戸市東原 3-3-41	(電0292-26-0622)	アンモナイト，層序
高橋　和	64	西条市南中	799-11	愛媛県周桑郡小松町妙口 728		花粉
高橋　豊	78	沼津北部高	410	沼津市岡一色 875		
*高安　泰助	51	秋田大鉱山地質	010	秋田市旭南 2-5-23	(電0188-62-4261)	貝類，生層位
*高柳　洋吉	48	東北大理地質古生物	982	仙台市八木山東 2-21-2	(電0222-29-1125)	有孔虫，分類，層序
*高山　俊昭	62	金沢大教養地学	921	金沢市長坂台 4-19	(電0762-43-8562)	石灰質ナンノプランクトン，層序
滝沢　茂	71	筑波大地球科学	300-32	茨城県筑波郡谷田部町大字谷田部 2221-5．同左		コノドント
田口　栄次	80	広島大理地鉱	733	広島市中区吉島東 1-14-11		貝類，層序
竹内　貞子	64	斉藤報恩会自然史博	980	仙台市上杉 3-9-12	(電0222-21-4087)	花粉，層序
竹谷陽二郎	77	東北大理地質古生物	980	仙台市千代田町 4-21 藤村百合子方	(電0222-34-3651)	放散虫
武智　雅美	70	吉田小	733	広島市古江西町 18-43，同左		
武永　重夫	57		255	神奈川県中郡大磯町東小磯374		層位
武南　馨	56	福生高	191	東京都日野市 3-15-1，7-108	(電0425-84-8454)	植物
竹原　平一	35	椙山女学園大	466	名古屋市昭和区福原町 3-16	(電052-781-0601)	層序
田沢　純一	72	東北大理地質古生物	982	仙台市三神峯一丁目3番 4-501号	(電0222-44-3396)	腕足類，層序
*田代　正之	63	高知大理地質	780	高知県高岡郡佐川町加茂 51-3	(電08892-2-7252)	中生代
多田　元彦	66	岩手大工資源開発	020	盛岡市北山 2-14-36	(電0196-62-2349)	層位，堆積

*橘	行一	61	岩手大教育地学	020	盛岡市上田 3-18-22		腕足類，層位
*立岩	巌	35		155	東京都世田谷区代田 6-27-3	(電03-466-4079)	構造地質
立松	泰夫	78		281	千葉市花見川 3-17-601		層序
*棚井	敏雅	48	北大理地鉱	060	札幌市豊平区平岸 1-5-3 B5-201	(電011-841-6504)	植物
田中	邦雄	48	信州大教養地学	390	長野県松本市元町 3-8-26	(電0262-33-9497)	生層位，軟体動物
*田中	啓策	58	地調地質	192-02	東京都多摩市豊ヶ丘5-1-2-502	(電0423-76-1535)	層序
田中	哲夫	77	日本石油開発(株)	194-01	東京都町田市三輪町 1554	(電044-988-0657)	層位
棚部	一成	71	愛媛大理地球科学	790	松山市東長戸町 4-3-1，愛媛大宿舎 242 号	(電0899-22-2956)	頭足類，生態と進化
谷村	好洋	78	国立科博地学	191	東京都日野市日野 6450-2，白梅コーポ 202	(電0425-86-0960)	珪藻
胤森	礼儀	53	芦屋高	673	兵庫県明石市藤江若林1081-23	(電078-923-4611)	二枚貝，層序
田宮	良一	69	山形県鉱業課	990	山形市旅籠町 3-4-51		
*田村	実	51	熊本大教育地学	860	熊本市黒髪町 2-40-1，同左	(電0963-68-5683)	二枚貝，層序
田吹	亮一	79	東大理地質	110	東京都台東区谷中 2-1-25 古川方	(電03-823-6350)	新生代貝形類

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*千坂	武志	48	千葉敬愛短大	167	東京都杉並区下井草 3-33-16	(電03-396-5620)	紡錘虫
*千地	万造	58	大阪市立自然史博	596	大阪府岸和田市並松町 10-2	(電0724-22-1540)	有孔虫，生層位
千葉	昇	80	愛媛大理地球科学	790	愛媛県松山市文京町2-5，同左		コノドント
*鎮西	清高	56	東大理地質	227	横浜市緑区市ヶ尾町 1154-2 市ヶ尾プラーザ 701	(電045-971-7064)	生態学，軟体動物

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塚野	善蔵	40		916	福井県鯖江市御幸町 2-5-14	(電0778-51-6058)	層序
辻井	正則	79	東京学芸大地学	174	東京都板橋区若木 2-25-9	(電03-932-8825)	植物
*津田	禾粒	50	新潟大教養地学	950-21	新潟市寺尾村上 700	(電0252-69-2994)	軟体動物，新生代層位
*土	隆一	50	静岡大理地球科学	420	静岡市東千代田 2-26-28	(電0542-61-4590)	貝類，層序
綱田	幸司	78	早稲田大理工資源	167	東京都杉並区善福寺 1-29-21-201	(電03-394-8414)	材化石
津村	孝平	66	神奈川県立外国語短大	221	横浜市神奈川区松ヶ丘 14		珪藻
*鶴田	均二	35		113	東京都文京区西片 2-7-15		石油地質

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*徳永	重元	44	パリノ・サーヴェイ(株)	160	東京都新宿区百人町 2-17-18	(電03-371-4009)	花粉，層序

徳山　明	54	兵庫教育大	675	兵庫県加古川市加古川町木村 669-5	(電0794-21-3534)	構造地質
利光　誠一	80	九大理地質	812	福岡市東区原田 1-10-15 水上秀生方		
富沢　昭文	77	帝国石油(株)技研	156	東京都世田谷区松原 6-8-17	(電03-322-4240)	有孔虫，石油地質
冨田　幸光	74		488	愛知県尾張旭市東印場町3257-8，冨田花男方		
富永　振作	74	新日本技術コンサルタント(株)	210	川崎市川崎区小田 2-8-19	(電044-333-2470)	
都郷　義寛	78	北海道教育大岩見沢分校	001	札幌市北区屯田 4-4-175		軟体動物，石灰化作用
戸塚　洋子	80	東京学芸大地学	164	東京都中野区中野 5-45-14	(電03-387-0300)	層位
*鳥山　隆三	38	福岡大理地学	814	福岡市西区西新 1-4-8	(電092-821-2163)	古生代有孔虫

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*内藤源太朗	57	防府商高	747	山口県防府市東松崎町 9-26	(電0835-23-1292)	前期中生代植物
中井　均	79	麻布獣医大教養自然科学	177	東京都練馬区高野台 5-28-5 白山荘3号室		古生代サンゴ，層序
長井　孝一	76	九大教養地学	805	北九州市八幡東区枝光 3-1-20	(電093-662-5558)	層序
永井　節治	76	木祖中	369	長野県木曾郡南木曾町読書下仲町	(電02645-7-8611)	第三紀軟体動物
仲川　隆夫	73	新潟大教養地学	950-21	新潟市五十嵐二ノ町8050，同左		
中沢　克三	65		380	長野市大字若槻団地 1-490		
*中沢　圭二	48	京都大理地鉱	606	京都市北区小山下内河原町 42	(電075-491-2506)	二枚貝，層序
中道　修	69	北川鉱業(株)技術部生産課	921	金沢市神田町同左		
*永沢　譲次	35	聖徳学園短大	165	東京都中野区江古田 2-22-14	(電03-386-1912)	軟体動物，哺乳類，生態
中島　浩一	77	徳山曹達(株)	745	徳山市新堀 6684 雄心寮	(電0834-31-0142)	コノドント，層序
中島　秀一	77		112	東京都文京区後楽 2-17-5	(電03-812-1427)	
中筋　治雄	79	北大理地鉱	063	札幌市西区発寒 12-3-8	(電011-661-2279)	植物，層序
*中世古幸次郎	62	大阪大教養地学	565	大阪府吹田市桃山台 3-184	(電06-834-2724)	放散虫，層序
長瀬　和雄	62	神奈川温泉地学研	241	横浜市旭区本村町 57-6	(電045-362-0448)	応用地質
長田　享一	69	石油資源開発(株)技研	190-11	東京都西多摩郡羽村町緑ケ丘 3-5-5，同左		放散虫
*中野　光雄	50	広島大理地鉱	737	広島県呉市三条 1-13-25	(電0822-21-4346)	中・新生代二枚貝
*中村　耕二	58	北大理地鉱	001	札幌市北区新琴似11条8丁目1の17	(電011-761-8722)	腕足類
*中村万次郎	67	東京理大理工	273	千葉県船橋市丸山 1-21-15	(電0475-38-3530)	石灰藻，層序
中森　亨	80	東北大理地質古生物	980	仙台市荒巻字青葉，同左		サンゴ
*奈須　紀幸	50	東大海洋研	162	東京都中野区南台1-15-1，同左		海洋地質，堆積

*名取　博夫	62	地調燃料	305	茨城県筑波郡谷田部町東 1-1-3，同左		有孔虫，生層位
成瀬　武彦	67	航空自衛隊 第4術科学校	369-03	埼玉県児玉郡上里町 神保原町 122	(電0495-33-9163)	生層位，紡錘虫

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*新妻　信明	66	静岡大理 地球科学	422	静岡市小鹿 3-3-1，154	(電0542-83-8072)	有孔虫，同位体
西尾　敏夫	36	帝京大文	177	東京都練馬区東大泉 5-10-8	(電03-922-2966)	層序
西川　功	53		728-18	広島県神石郡油木町油木乙 1797	(電08478-2-0353)	
西川　誠	66		943	新潟県上越市仲町 3-7-11		生層位，有孔虫
西川　康行	72	奈良工業高	630	奈良市法蓮呉竹町 1514	(電0742-23-9325)	層序
西沢　勇	78	中日新聞社(株)	463	名古屋市守山区小幡常灯 95	(電052-791-2235)	
*西田　史朗	67	奈良教育大地学	631	奈良市敷島町 1-543-53	(電0742-48-8313)	ナンノプランクトン，層序
*西田　彰一	36		950	新潟市小張木 171-3	(電0252-44-5425)	
西田　民雄	62	佐賀大教育地学	840-01	佐賀市高木瀬町大字高木 1240-13	(電0952-30-6107)	軟体動物，層序
西宮　克彦	71	山梨大教育地学	400	山梨県甲府市武田 3-5-19	(電0552-53-7297)	層序，地史
西村　明子	75	大阪大教養地学	565	大阪府豊中市新千里東町 2-7 C 20-102	(電06-833-0446)	放散虫
西村　昭	75	地調海洋地質	305	茨城県新治郡桜村吾妻2丁目 905-506	(電0298-51-9676)	海洋地質，有孔虫
西村はるみ	80	東京学芸大地学	164	東京都中野区東中野 3-13-1	(電03-371-8858)	層位
西脇　二一	67	京大理地鉱	606	京都市左京区北白川上 池田町 10　百成荘 101 号室	(電075-781-2537)	花粉，数理地質
二本木光利	80	札幌学映	064	札幌市中央区南8西 22	(電011-561-9037)	アンモナイト

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沼野恭一郎	62	日高高	649-15	和歌山県御坊市名田町 上野 1465	(電07382-9-2015)	中生代層序

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根本　修行	74	三阪小	970-13	福島県いわき市三和町差塩字 道添 108	(電0246-86-2047)	軟体動物

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*野上　裕生	57	京大霊長研	616	京都市右京区鳴滝春木町 5-23	(電075-461-8282)	生鉱物
野苅家　宏	78		270	千葉県松戸市小金 444-109	(電0473-44-5043)	脊椎動物
*野田　浩司	61	筑波大地球科学	300-31	茨城県新治郡桜村大字妻木字 天久保，同左		軟体動物
*野田　雅之	66	稚田東中	870	大分市深河内5組	(電0975-44-4332)	イノセラムス，層序
*野田　光雄	35		815	福岡市南区大橋 4-29-6	(電092-541-0293)	層位

野原	朝秀	69	琉球大教育地学	903	那覇市当蔵町３の１，同左		貝形類，哺乳類
野村	隆光	79	愛知教育大地学	488	愛知県尾張旭市霞ヶ丘町中245	(電052-798-0026)	脊椎動物
野村	宏美	80	千葉大理地学	132	東京都江戸川区船堀 1-5-12-201	(電03-687-2782)	紡錘虫
野村	律夫	74	東北大理 地質古生物	980	仙台市荒巻字青葉，同左		有孔虫

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配川	武彦	72	秋吉台科博	754-06	山口県美祢郡秋芳町嘉万 1922	(電08376-5-2220)	サンゴ，層序
*橋本	勇	53	九大教養地学	815	福岡市南区長住 6-10-29	(電092-561-3847)	層序
橋本	恭一	67	山口県立博	747	山口県防府市祖原 2-2	(電0835-21-0464)	フズリナ，石灰岩
*橋本	亘	50	資源コンサルタント	177	東京都練馬区東大泉 3-23-7	(電03-923-3378)	層孔虫，大型有孔虫，層序
*長谷	晃	50	広島大理地鉱	738	広島県佐伯郡廿日市町 佐方月見台 615-49	(電0829-32-3565)	地史，地域地質
長谷弘太郎		65	長谷地質調査(株)	980	仙台市本町 3-5-8，同左		地質
長谷	義隆	75	熊本大理地学	862	熊本市渡鹿 1-16-5-24	(電0963-62-1549)	植物，層序
長谷川四郎		73	東北大理 地質古生物	982	仙台市萩ヶ丘 28-10 第一白萩荘5号		有孔虫，層序
長谷川淳一		74		350-02	埼玉県坂戸市末広町 9-18		
長谷川康雄		67	県立高田盲学校	943	新潟県上越市北城町 1-6-30	(電0255-24-3309)	珪藻
*長谷川善和		56	横浜国大教育	249	神奈川県逗子市沼間 3-16-15	(電0468-71-4353)	脊椎動物，分類
*長谷川美行		61	新潟大教養地学	950-21	新潟市五十嵐２の町 7492-128	(電0252-61-0059)	紡錘虫
八田	明夫	77	木更津東高	299-12	千葉県富津市下飯野 973-9	(電04398-7-8517)	有孔虫
波田	重熙	65	高知大理地質	780	高知市福井町 2113-52	(電0888-22-0863)	構造地質
服部	修一	77	鉄建公団 竜飛鉄道建設所	030-17	青森県東津軽郡三厩村竜浜 54，公団職員寮	(電01743-8-2410)	土木地質
*花井	哲郎	48	東大理地質	152	東京都目黒区八雲 5-18-24	(電03-717-0876)	貝形虫
*波部	忠重	51	東海大海洋水産	201	東京都狛江市和泉 3146-17	(電03-480-5820)	貝類，分類生態
浜田	潤一	64	新遠屋町小	761-42	香川県小豆郡土庄町伊喜末 1823-3	(電08796-4-5723)	三葉虫，層位
*浜田	隆士	55	東大教養 宇宙地球科学	167	東京都杉並区天沼 2-20-1	(電03-393-5338)	無脊椎動物，地史
原	卓郎	62		759-13	山口県阿武郡阿東町生雲	(電08395-4-0781)	脊椎動物
原田	憲一	75	山形大理 地球科学	990	山形市大野目 1-4-27	(電0236-31-1544)	ダイノフラゲラータ
原田	耕嗣	77	呉市立両城中	737-01	広島県呉市広町 9727-1	(電0823-71-7997)	軟体動物，層序
*早坂	祥三	54	鹿児島大理地学	892	鹿児島市吉野町 11，119-3	(電0992-43-8080)	貝類，層序
林	明	76	越谷南高	332	埼玉県北葛飾郡吉川町 吉川団地 1-2-502		新生代有孔虫，層位
林	慶一	80	東大理地質	113	東京都文京区本郷 5-3-10 ニューコーポ二原堂 301 号		貝形虫，層序
林	信悟	58	大間々高	376-01	群馬県山田郡大間々町 1226-4	(電02777-2-3543)	コノドント

林	唯一	51	愛知教育大地学	448	愛知県刈谷市井ケ谷町広沢1，同左		第三紀軟体動物
林	徳衛	69		811-52	長崎県壱崎郡石田町 1091	(電09204-4-6311)	層序
*速水	格	54	東大総合研究資料館	166	東京都杉並区成田東 1-40-30	(電03-315-4963)	軟体動物，生物進化
速水	倶子	69	愛媛大教育地学	790	松山市木屋町 3-8-4	(電0899-24-2417)	新生代のこけ虫
伴	慎介	78	インドネシア石油(株)	154	東京都世田谷区下馬 3-11-12 ドエル下馬 103号		石油地質，層序
*坂東	裕司	56	香川大教育地学	761-04	香川県高松市川島東町 497-14	(電0878-48-2643)	頭足類，層序

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樋口	雄	51	合同石油開発(株)	248	神奈川県鎌倉市手広 1292-1 西鎌倉コーポ 903	(電0467-32-1403)	有孔虫，石油地質
久光	正雄	69		029-43	岩手県胆沢郡衣川村富田 65	(電019752-3076)	紡錘虫
日高	稔	62	上野丘高	870-03	大分市大字細 170	(電0975-2-2402)	第四系層序
平川	昌登	78		177	東京都練馬区石神井台 4-1-4-105		地史
*平野	弘道	65	早大教育地学	242	神奈川県大和市下鶴間 3428 コーポ下鶴間 1-122	(電0462-75-9367)	頭足類進化学
*平山	勝美	48	立教大一般教育地学	165	東京都中野区江原町 1-33-10	(電03-951-9455)	軟体動物

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深田	淳夫	51	応用地調	184	埼玉県熊谷市本町2-78	(電0485-21-3307)	アンモナイト，層序
*福田	理	48	地調燃料	305	埼玉県熊谷市本町 2-78	(電0485-21-3307)	有孔虫，天然ガス鉱床
福田	芳生	68	千葉県衛生研	284	千葉県印旛郡四街道町 1585	(電0434-82-4938)	甲殻類，生態
*藤	則雄	61	金沢大教育地学	920	金沢市丸ノ内 1-1，同左		花粉
藤井	英一	80	明正高	154	東京都世田谷区梅丘 2-9-24，同左		化石材
*藤井	昭二	55	富山大教養地学	930	富山市安養坊 161-2	(電0764-41-7142)	軟体動物，層序
*藤岡	一男	38	秋田県立農業短大	010	秋田市旭川新藤田東町 14-20	(電0188-33-8613)	大型植物，層序
藤島	泰隆	74	川崎地質	982	宮城県仙台市鹿野 1-3-35	(電0222-46-1244)	層序
藤田	郁男	60	北海道教育センター地学	064	札幌市中央区宮ノ森 4条 7-32，同左		新生代巻貝，生痕，層位
*藤山	家徳	65	国立科博地学	160	埼玉県和光市白子 3-19-6-502	(電0484-64-8176)	昆虫
船津	宏	80	因島高	722-23	広島県因島市土生町郷区 1204-3たちばな荘	*(電08452-2-6225)	層序，軟体動物
古市	光信	80	香川県自然科学館	769-23	香川県木田郡三木町井戸 2269	(電08795-2-3763)	花粉，層序
古川	隆治	69	帝石技研	158	東京都世田谷区深沢 5-12-1 玉川アパート	(電03-703-1308)	地質
Frydl, Paul		80	東大理地質	112	東京都文京区大塚 4-20-14 グリーンガーデン 2C	(電03-945-0052)	貝形虫

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北条	凱生	63	戸畑高	806	北九州市八幡西区若葉1-15-44	(電093-641-6604)	大型植物，層序
堀内	順治	77	筑波大地球科学	201	東京都狛江市和泉 2734	(電03-489-9377)	植物
堀口	敏秋	73	資源コンサルタント	238	神奈川県横須賀市吉倉町 1-5		
堀口	万吉	58	埼玉大教養地学	338	浦和市上木崎 519-22	(電0488-31-9935)	石灰藻，層序
*堀越	増興	48	東大海洋研	153	東京都目黒区目黒 1-3-31 パビヨン目黒 302	(電03-492-5070)	軟体動物，海洋ベントス学
本田	信幸	77	東北大理 地質古生物	982	仙台市八木山松波町 17-25 松波荘	(電0222-47-4601)	石灰質ナンノ化石
本田	博巳	74	石油資源開発(株)技研	192-02	東京都多摩市一ノ宮 947-18		生態
本田	裕	73	三重大教育地学	514	三重県津市上浜町 2-102 ＡＢマンション 2Ｅ		新生代軟体動物化石の分類，生層序，地理学

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*米谷盛寿郎		68	石油資源開発(株)技研	180	東京都武蔵野市吉祥寺北町 3-8-12-113		有孔虫
*前田	四郎	51	千葉大理地学	272	千葉県市川市菅野 2-3-7	(電0473-22-8224)	層序，地史
前田	晴良	80	東大理地質	140	東京都品川区南大井 1-14-6		
*前田	保夫	63	神戸市立教育研究所	657	神戸市灘区桜ヶ丘町 10-45	(電078-841-2438)	花粉，層序
牧野	融	78	慶応大	248	神奈川県鎌倉市七里ヶ浜3-6-3		
正谷	清	58	北海石油(株)	359	埼玉県所沢市北秋津 461-8	(電0429-24-2973)	三角貝，石油地質
*増田孝一郎		52	宮城教育大地学	980	仙台市荒巻字青葉山，同左		貝類，層序
*増田富士雄		70	筑波大地球科学	300-31	茨城県新治郡桜村妻大字天久保，同左		地球化学，層位
松居誠一郎		77	宇都宮大教育地学	321	栃木県宇都宮市峰町350，同左		軟体動物
松浦	信臣	80	石川県教育センター	920-03	石川県金沢市金石東 2-7-9	(電0762-67-3354)	貝化石，地質
*松尾	秀邦	48	愛媛大理地球科学	790	松山市文京町 2-5，同左		植物
松尾	康弘	67	明法高	167	東京都杉並区松庵 3-16-25	(電03-332-1836)	
松岡	数充	71	長崎大教養地学	859-06	長崎県西彼杵郡長与町三根郷 53-127，合同宿舎 1-52	(電09588-3-7069)	渦鞭毛藻，層序
松川	正樹	72	愛媛大理地球科学	791-31	愛媛県伊予郡松前町恵久美 合同宿舎 542		白亜紀アンモナイト，層序
*松隈	明彦	69	国立科博動物	153	東京都目黒区大橋 2-17 大橋住宅ＲＡ14	(電03-460-9552)	軟体動物，系統分類
*松下	進	35		606	京都市左京区吉田上阿達町 30	(電075-771-6753)	地史
*松島	義章	68	神奈川県博	247	神奈川県鎌倉市植木 842-8 ヒルハイツ鎌倉Ｂ-302	(電0467-43-3127)	軟体動物，層序

松末　和之	80	九大理地質	812	福岡市東区箱崎 6-10-1，同左		フズリナ
松田　丞司	73	国際航業	400	山梨県甲府市貢川本町4-31		
松田　伸也	79	金沢大理地学	920	金沢市丸ノ内，同左		造礁生物
松田　哲夫	75	大阪市大理地学	612	京都市伏見区向島庚申町 96-7	(電075-611-7581)	コノドント
*松永　　孝	48	松永ジオサーベイ(株)	150	東京都渋谷区桜ヶ丘 16-2 アケボノビル 4F	(電03-461-7741)	有孔虫
松永二三郎	72		272	市川市本北方 3-2-5		層位，堆積
松原　恵司	80	千葉大理地学	175	東京都板橋区赤塚 4-15-12	(電03-938-8616)	コノドント，フズリナ，層位，構造地質
*松丸　国照	66	埼玉大教育地学	336	浦和市別所 4-7-5	(電0488-64-8443)	大型有孔虫，層序
松本　達也	80		860	熊本市城山大塘町 533	(電0963-29-8258)	軟体動物
*松本　達郎	35		812	福岡市南区南大橋 1-28-5	(電092-541-6348)	頭足類，層序，イノセラムス
*的場　保望	62	秋田大鉱山地質	010	秋田市手形休下町 9-33 秋田大学宿舎	(電0188-34-9770)	有孔虫，層序
*馬淵　精一	35		184	東京都小金井市貫井南町 4-18-3	(電0423-81-5027)	層序
丸山　俊明	79	東北大理地質古生物	980	仙台市上杉6-2-19 高橋方		珪藻，層序

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三井さち子	76	広島大理地鉱	730	広島市中区東千田町 1-1-89，同左		炭酸塩岩
三枝　利光	80	東京学芸大地学	185	東京都小金井市貫井北町 5-1-9厚沢方		植物
*三上　貴彦	62	文部省初等中等教育局	174	東京都板橋区常盤台 4-2 RC-104	(電03-937-3215)	層序
三木　昭夫	67	芙蓉石油開発	270	千葉県松戸市南松戸 7-221 サンライトパストラル五番街D-1407	(電0473-45-8317)	花粉
三木　　孝	70	九大理地質	812	福岡市博多区山王 1-17-17 第3よしみビル 702	(電092-473-8806)	第三紀，堆積
水谷伸治郎	56	名大理地球科学	465	名古屋市名東区代万町 2-21	(電052-702-0646)	放散虫
*水野　篤行	51	地調・海洋地質	166	東京都杉並区和田 1-44-30	(電03-382-8421)	海洋堆積，新生代軟体動物
三谷　勝利	62	北海道地下資源調	062	札幌市豊平区月寒東3条3丁目	(電03-852-8974)	層位
箕浦　幸治	73	弘前大理地球科学	036	弘前市樹木 1-26-16 樹木荘5号		六射珊瑚，堆積
三本　健二	78	室戸保健所	781-71	高知県室戸市浮津 1374-1	(電08872-3-0696)	
宮下　　治	79	東京学芸大地学	116	東京都荒川区東尾久 3-13-9	(電03-892-4975)	花粉，層序
宮原　哲仁	80	北野高	110	東京都台東区谷中 3-1-15	(電03-821-8774)	
宮田雄一郎	73	九大理地質	812	福岡市東区箱崎 6-10-1，同左		堆積

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*村井	貞充	51	岩手大工 資源開発	020-01	盛岡市緑ヶ丘 3-5-7	(電0196-61-6980)	植物，層序
*村田	正文	56	熊本大理地学	862	熊本市黒髪2-39-1	(電0963-67-0641)	古生代軟体動物 層序
村松	二郎	76	千葉大	180	東京都武蔵野市西久保 2-18-3	(電0422-51-9058)	紡錘虫
村松	憲一	70	中村高	467	名古屋市瑞穂区大殿町 3-3 川崎ビル 401	(電052-841-1367)	層序
村本喜久雄		74	三笠市立博	068-22	北海道三笠市弥生花園町 28-137	(電01267-6-8190)	白亜紀 アンモナイト
村本	辰雄	63		068-22	北海道三笠市弥生花園町 28-137	(電01267-6-8190)	白亜紀 アンモナイト

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桃井	京子	80	東京学芸大地学	222	横浜市港北区太尾町 1962	(電045-541-2252)	植物
森	群平	79		939-07	富山県下新川郡朝日町泊 454	(電07658-3-2004)	植物
*森	啓	62	東北大理 地質古生物	980	仙台市土樋 236 愛宕橋マンションファラオA-02	(電0222-23-4784)	層孔虫， 六射サンゴ
森	忍	75	名大理地球科学	458	名古屋市緑区鳴海町明願 1-3	(電052-621-4315)	珪藻，層序
*森下	晶	47	名大理地球科学	464	名古屋市千種区不老町，同左		新生代ウニ， 生層位
森田	利仁	79	早大教育地学	154	東京都世田谷区豪徳寺 1-14 牟田あき方		生層序
*両角	芳郎	69	大阪市立 自然史博	583	大阪府曳羽野市翠鳥園 6-15	(電0729-56-7582)	有孔虫，層序

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*八尾	昭	69	大阪市大理地学	630	奈良市南半田中町 7	(電0742-23-5274)	放散虫
矢島	道子	74	東大理地質	276	千葉県八千代市高津 390-179	(電0474-59-2261)	貝形虫，分類
安田	尚登	78	東北大理地質 古生物	980	仙台市荒巻字青葉無番地 菊地方	(電0222-29-2642)	有孔虫，層序
柳井	修一	80	東大理地質	174	板橋区相生町 25-25		構造地質
柳沢	一郎	67	いわき短大	970	福島県いわき市平幕ノ内 字田中 1	(電0246-74-7716)	層位，腕足類， 二枚貝
柳沢	学	70		484	愛知県犬山市羽黒中深田 1-20	(電0568-67-1949)	
*柳田	寿一	58	九大理地質	816	福岡県春日市春弥永 227	(電092-585-9176)	石炭紀～ペルム 紀，腕足類
山形	理	53	山形大教養地学	990	山形市小白川町 1-14-23	(電0236-22-0790)	花粉
*山際	延夫	55	大阪教育大地学	591	堺市新金岡町 3-1，14-102	(電0722-51-6818)	中，古生代珊瑚 紡錘虫
*山口	寿之	67	東大理地質	231	横浜市中区千代崎町 2-71-2-404	(電045-623-0395)	蔓脚類， 系統進化
山崎	純夫	77	早大理工資源	177	東京都練馬区下石神井 1-345	(電03-929-2373)	材化石，石炭
*山崎	達雄	53	九大生産研	813	福岡市東区香住ヶ丘 6-19-5	(電092-681-1919)	層序
山田	純	48		514	津市大谷町緑ヶ丘 97-39	(電0592-28-8441)	第四紀層位

山田彌太郎	51	一戸高	020	盛岡市山岸5丁目 15-31	(電0196-61-3563)	層位
山野井　徹	73	山形大教養地学	990	山形市小白川町 5-25-28-8	(電0236-31-4357)	花粉，層序
山本　滋樹	76	明正高	167	東京都杉並区上荻 2-13-20 渡辺馨一方	(電03-399-7832)	珪藻，貝形虫，層序

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横尾　浩一	73	葛飾区教育委員会	154	東京都世田谷区三宿 2-33-18-104	(電03-413-4093)	地学教育
横川　　巌	71	基礎地盤コンサルタンツ(株)	663	兵庫県西宮市南甲子園 3-10-5 南甲ハウス 35 号		
横山　鶴雄	58	小野田セメント(株)	441-34	愛知県渥美郡田原町 豊安原崎 22		
横山　道昭	71	広島大学附属高	734	広島市南区霞 2-6-20 新川ビル 402	(電0822-51-6318)	腕足類，層序，地学教育
*吉田　三郎	48	山形大教育地学	990	山形市小立 3-3-27	(電0236-23-2306)	有孔虫，層序
吉田　新二	50	愛知教育大地学	467	名古屋市瑞穂区田光町 2-36	(電052-881-7602)	新生代層位
吉田　　尚	42	地調地質	213	川崎市高津区野川 3777-8	(電044-777-0418)	コノドント，層序
吉田　照喜	80		663	西宮市長田町 3-2		
吉田　俊秀	79	九大理地質	812	福岡県福岡市東区原田1-17-25 山田久雄方	(電092-611-4691)	新第三紀軟体動物
吉田　史郎	73	地調大阪出張所	631	奈良市西大寺栄町 3-3 大塚文化住宅 2-東2		
吉野　道彦	64	名城大理工教養地学	482	愛知県岩倉市栄町 1-44	(電0587-37-0886)	花粉，第四紀地史

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由井　誠二	72	インドネシア石油(株)	105	東京都港区芝西久保明舟町16 第15森ビル7階		

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渡辺其久男	69	石油資源開発(株)	950	新潟市本馬越 756-4	(電0252-45-0806)	有孔虫，生層位
*渡辺　耕造	68	東葛飾高	160	新宿区新宿 1-12-12 小貫方	(電03-341-9388)	紡錘虫
*渡部　景隆	48		184	東京都小金井市本町 5-24-30	(電0423-85-2312)	層序
*亘理　俊次	51		272	千葉県市川市八幡 5-12-18		植物(材化石)

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窯業協会	160	東京都新宿区百人町2-22-17（電03-362-5231）

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北海道大学低温科学研究所	060	札幌市北区北18条西８丁目（電011-711-2111）
北海道立地下資源調査所（三谷）	060	札幌市北区北18条西12丁目（電011-742-2211）
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〃　資源調査所	100	東京都千代田区霞ヶ関2-2（電03-581-5271）
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〃　農業土木試験所	300-21	茨城県筑波郡谷田部町観音台2-1-2（電02975-6-7513）
〃　林業試験所	305	茨城県稲敷郡茎崎村松の里1（02987-3-3211）
三菱金属中央研究所	330	埼玉県大宮市北袋町1-297（電0486-41-5111）
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〃　〃　名古屋出張所	460	名古屋市中区三ノ丸2-5-2　名古屋通産局総合庁舎内（電052-951-6416）
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〃　〃　中国出張所	730	広島市中区上八丁堀6-30　広島合同庁舎３号（電0822-21-1945）
〃　〃　四国出張所	760	高松市番町1-10-6　四国通産局内（電0878-31-3254）
〃　〃　九州出張所	810	福岡市南区大字塩原字アイゾ497-2（電092-551-6099）
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信州大学理学部地質学教室	390	松本市旭3-1-1（電0263-35-4600）
〃　教養部地学教室（田中）	〃	〃　〃
〃　教育学部地学教室（斎藤）	380	長野市西長野町袖長野６（電0262-32-8106）
山梨大学教育学部地学教室（西宮）	400	甲府市武田町4-4-37（電0552-52-1111）
東海大学海洋学部資源学教室	424	清水市折戸1000（電0543-34-0411）
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〃　教養部　〃	〃	〃　〃
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京都工芸繊維大学工芸学部無機材料工学科	606	京都市左京区松ガ崎（電075-791-3211）
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〃　教養部地学教室（後藤）	〃	神戸市灘区鶴甲1-2-1　（　〃　）
〃　教育学部　〃	〃	神戸市灘区鶴甲3-11　（　〃　）
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〃　教養部地学教室（浦田，長井，橋本）	810	福岡市中央区六本松4-2-1（電092-771-4161）
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〃　教養部　〃　（今西）	〃	〃　（　〃　）
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〃　教育学部　〃　（野原）	〃	〃
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北海道大学農学部附属博物館	060	札幌市中央区北3条西8丁目（電011-251-8010）
夕張市立石炭博物館	068-04	夕張市高松７番地（電01235-2-3417）
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秋田大学鉱山学部付属鉱業博物館	010	秋田市手形字大沢28-2（電0188-33-5260）
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工業技術院地質調査所地質標本室	305	茨城県筑波郡谷田部町東1-1-3 （事務室，電0298-54-3750；受付，電0298-54-3751； 尾上，電0298-54-3755；神戸，電0298-54-3754）
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千葉県立上総博物館	292	木更津市太田山公園内（電0478-23-0011）
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（電話 ８１２－２１１１ 内線 ２８３０）

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○ 管理の態勢が不十分であったために、行方不明になっている図書（目録で欠本になっているものの一部）が若干あります。 もし所在を御存知の方がありましたら、上記に連絡いただけると幸いです。学会所有の図書にはすべて学会のゴム印が押してあり、登録番号が記入されています。

日本古生物学会蔵書目録

外国雑誌類

○ 雑誌名はアルファベット順に配列し、雑誌の別名や英・仏訳のあるもの、途中で誌名の変ったものは角括弧で示してあります。

○ 巻・号の区別のあるものは、巻数のあとに号数を括弧で表示し、その巻の各号がそろっている場合には号数を省略してあります。 「－」はその間の巻または号がそろっていることを示します。

○ 発行年は保有する巻・号の最初と最後のものについてだけ表示してあります。

○ 一部だけが欠本となっている場合は、連続する巻・号の表示のあとに角括弧で示してあります。

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